Massachusetts Bay Transportation Authority

Worcester Commuter Rail Service Improvements
Conceptual Design Report

Worcester-Millbury-Grafton, Ashland-Framingham

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EXECUTIVE SUMMARY

Project Purpose and Need

The Massachusetts Bay Transportation Authority is evaluating track improvements to provide increased frequency of service on 23 miles of the Framingham/Worcester Line. This study evaluates the feasibility of the addition of a third freight rail track that would extend approximately 1.7 miles west from the CSX Nevins Yard in Framingham and approximately 4.3 miles east from the Worcester freight yard, with an additional ½ mile freight lead extension in Worcester Yard. The addition of a third track in these areas is intended to reduce capacity constraints on the CSX main track and would provide the opportunity for the MBTA to add more commuter trains to its existing service schedule. The goal of the Worcester Service Improvements Project is to increase mid-day service between Framingham and Worcester.

The existing Framingham/Worcester Line extends 44 miles from South Station in Boston to Union Station in Worcester. This line was one of the very early passenger lines in New England, with service commencing in 1835. Service to Worcester was suspended in 1975, although Framingham service continued. Service resumed to Worcester in 1994, as part of the Worcester Commuter Rail Extension. Ridership increases over the past five years have been significant, particularly at the newer western stations, and is forecasted to increase by 50% over the next decade, according to the results of the *Draft Final Report on the Worcester Service Expansion Study* (March 2003), prepared by KKO and Associates, LLC for the MBTA.

Commuter rail service on the line, also known as the Boston & Albany Line, operates on track owned by CSX between Framingham and Worcester. The Boston & Albany Line is owned and operated by CSX Transportation (CSX) railroad with the MBTA and Amtrak operating over this line under agreements with CSX. The Framingham/Worcester Line is the most frequently used freight line in New England. Due to growing demand for passenger service between the two largest cities in New England, the line was upgraded to a two-track system as part of the 1994 expansion of commuter rail service from Framingham to Worcester. The Framingham/Worcester commuter rail line is generally a 60 mph double-track railroad with a sophisticated signal system, which allows trains to operate on either track in either direction. A series of crossovers at interlockings or control points, allows trains to run around slower trains or around maintenance work on sections of track. The track structure is generally in good to excellent condition. In addition to MBTA commuter rail service and CSX freight service, the line also accommodates Amtrak service operating to Albany, with connections to Springfield, New York City and Chicago.

The 1994 Worcester Commuter Rail Extension began operating with six trains per day from Framingham to Worcester. In 2001, this service was expanded to the current schedule of 10 round trip trains per day. Existing MBTA commuter rail service provides 20 round trip trains per day operating between Boston and Framingham, and, of these, 10 trains per day continue on to provide service to Worcester. Worcester area officials have pursued further improvements in commuter rail service to Union Station. The MBTA requested further expansion of service beyond the existing service agreements and authorized CSX to perform a capacity study in February 2003. This 2003 study recommended specific infrastructure investments to address capacity constraints identified by CSX. Subsequently, MBTA initiated this study to evaluate the CSX recommendations. In two sets of public and stakeholder meetings early in this project conducted in both Framingham and Worcester in June and July of 2004 and two public meetings in both communities held in May 2006, community representatives and the public have also expressed a strong belief that there is demand to support increased service to Worcester and the other stations west of Framingham.

Peak period service to Boston from Worcester (peak direction) operates on headways of 30 to 40 minutes in the A.M. peak and headways of 20 to 50 minutes in the P.M. peak. However, inbound service from Worcester to Boston operates at headways of every 2 to 3 hours during the mid-day and extending through the afternoon-evening peak period (non-peak direction). This compares to off-peak inbound service from Framingham that operates on headways of between 45 minutes and 105 minutes. In the outbound direction, off-peak service from Boston to Worcester operates on headways of 3 to 4 hours during the morning and mid-day, compared to headways of 1 to 2 hours for Framingham service.

Gaps in mid-day service can be attributed to conflicts with freight staging movements at CSX rail yards at Nevins Yard, west of Framingham Station, in Framingham and at Worcester Yard at the west end of the line. This Worcester Service Improvements Project examines track improvements on 6.5 miles of track at critical freight leads to minimize conflicts with freight traffic at CSX rail yard at Nevins Yard in Framingham and Worcester Yard. This study evaluates the addition of track in two segments: 1.7 miles of track extending west from Nevins Yard in Framingham to Control Point (CP) 24 in Ashland and 4.3 miles of track extending east from Worcester Yard through Millbury to CP39 in Grafton (plus the ½-mile yard lead).

These track extensions are the minimum level of improvement that CSX identified in the *MBTA Worcester Service Study* (July 2003) as necessary to allow mid-day service to Worcester to be increased. According to the CSX study, these track improvements would allow the MBTA to add four commuter trains per day to the MBTA schedule (two round trip trains). Of course, the actual level of commuter rail service to Worcester is dependent on negotiations with CSX, which owns and controls the line.

Project Description

Background

This report examines the minimum amount of track improvements outlined in the CSX study. Initial consideration was given to adding a third track along the entire 23 miles between Framingham and Worcester. However, this would require substantial capital improvements, including major modifications to recently constructed commuter rail stations at Ashland, Southborough, Westborough, and Grafton. This would also involve considerably greater environmental impacts, with construction required through the Westborough Cedar Swamp Area of Environmental Concern and the Grafton State Hospital National Register District. The service level improvements that would be provided with these track improvements are not commensurate with the substantial cost and impacts that would be involved. The scope for the current study focused on the track additions at the critical yard leads in Framingham and Worcester that would give CSX the added capacity necessary to allow the addition of commuter trains.

Ashland-Framingham Segment

In Framingham, the proposal is to extend the Third Iron from Nevins Yard west (from CP23) towards Ashland to the existing universal crossover interlocking at CP24 and establish a new connection to Track 1 at that point. That would allow even the longest trains to pull completely off the Main Line while assembling train sets in Nevins Yard, minimizing potential interference with the passenger operation. These freight train movements for assembling train sets can occupy up to more than a mile of track. Two options were evaluated for the connection near CP24 in Ashland: Option 1 would tie in east of the Main Street grade crossing and Option 2 would extend west towards CP24, involving a second grade crossing. Option 1 has been identified as the preferred option.

Available right-of-way is generally on the south side of the tracks in Ashland-Framingham, so the track addition would be accommodated on the south side of the existing tracks. Track 1 now occupies the outbound (north) side, and Track 2 occupies the inbound (south) side. In the future, the added track on the south would be designated as Track 2, accommodating inbound trains, existing Track 2 would become Track 1 (accommodating outbound trains), and the existing Track 1 on the north would accommodate all freight movements from Nevins Yard for assembling train sets. Through freight movements would still be accommodated on Tracks 1 and 2, but freight movements for assembling trainsets, which can occupy the track for a few hours at a time, will be entirely shifted to the northern freight lead.

In the Ashland-Framingham project segment, the tracks would be located on the existing maintenance road, and minimal grading would be required to accommodate the track addition. This section of track extends largely through Ashland, extending over Main Street at an at-grade crossing, under Fountain Street, and over the Sudbury River and Framingham Reservoir No. 2 (Brackett Reservoir). In Framingham, a section of track closely borders on Framingham Reservoir No. 2. The overhead and undergrade bridges also have sufficient width to accommodate the track additions, and no major culvert modifications are anticipated.

The track improvements along the Ashland-Framingham segment will involve the following:

- Terminating track improvements east of the Main Street grade crossing is identified as the preferred option (Option 1) over a connection at CP24 and an additional grade crossing at Main Street (Option 2). This design modification will require CSX approval.
- Installation of short ballast retaining walls (or headwalls) on top of bridges at the Sudbury River and Framingham Reservoir No. 2 are proposed. At the Framingham Reservoir No.2 Bridge (also known as the Sudbury River Bridge at Milepost 23.54), replacement of the bridge wingwalls on the same footprint is proposed. Replacement of the bridge wingwalls at the Framingham Reservoir No. 2 Bridge will involve temporary alterations to approximately 200 square feet of land under water and approximately 40 linear feet of bank. This work in the waterway will require filing of a Notice of Intent under the Massachusetts Wetlands Protection Act and coordination with the Massachusetts Department of Conservation and Recreation (MDCR), which has jurisdiction over Framingham Reservoir No. 2. No permanent alterations are anticipated as a result of this work.
- Where the tracks extend in close proximity to Framingham Reservoir No. 2 in Framingham, a 250-foot long retaining wall, 15 feet in height, is proposed to minimize incursions into the embankment adjoining the reservoir (Option 1). Alternatively, the two existing tracks could be realigned to avoid work in proximity to the reservoir (Option 2). This work under Option 1 may involve temporary alterations to approximately 160 linear feet of bank regulated under the Massachusetts Wetlands Protection Act, requiring a filing of Notice of Intent. Coordination with MDCR will also be required.
- Work will occur adjacent to an Estimated Habitat/Priority Habitat for a state species of special concern at the Sudbury River Bridge, but no work will occur within the Sudbury River. This work will require coordination with the Massachusetts Natural Heritage and Endangered Species Program to comply with the Massachusetts Endangered Species Act.
- Utilities relocations include potentially relocating the fiber-optic communications system (owned by Sprint) that extends along approximately 3,900 feet of this project segment. Either this system could be relocated during construction, or a spare (empty) conduit could be installed offset from the tracks for future use in case there are problems with the fiber-optic system installed below the tracks after track construction. Research on existing CSX utility agreements will be needed to determine the responsible party for the costs of utility relocations.
- Track realignments will affect approximately 4,110 square feet of property that largely adjoins parking for the Ashland Technology Center. This may affect the parking capacity of this lot, although most of the land affected consists of grassed buffer between the railroad and the parking lot.
- The total cost of the Framingham-Ashland segment is approximately $5.8 million.

Worcester-Millbury-Grafton Segment

The proposed change at Worcester is to provide a third track east of CP43 all the way to CP39 in Millbury/Grafton. This will alleviate the need for CSX to occupy Main Line Track 2 at Worcester and would allow MBTA and Amtrak trains to have double track all the way to CP44. In the Worcester area, both sides of the right-of-way are constrained, and the east end yard lead on the south side of Tracks 1 and 2 will be extended, with the track addition on the south side along most of this project segment. Where other constraints exist at bridge crossings, all three tracks would be relocated.

Along this segment, with the track addition, the freight movements for assembling trains could all be accommodated on the southernmost track, and designations for existing Tracks 1 and 2 will remain the same. These Main Line tracks (Tracks 1 and 2) will continue to accommodate through movements of MBTA rail passenger cars, Amtrak inter-city service, and through freight traffic. Additionally, in Worcester, CSX has asked for an extension of the east freight track yard lead approximately one-half mile to allow simultaneous moves to and from the intermodal yard. This lead should tie in east of the new crossover from Track 2 to the east end yard lead, which accommodates traffic to and from the intermodal yard. This will allow simultaneous moves to the Worcester Yard and intermodal tracks.

This section of track extends largely through Worcester and through portions of Millbury and Grafton, to the south and east. Roadways that cross over or under the track include, from west to east, Putnam Lane, Plantation Street, Hamilton Street, Sunderland Road, and U.S. Route 20. Properties that border on the south side of the track in Worcester include the Ecotarium, a non-profit, privately owned museum and nature center; North High School; and Perkins Farm Conservation Area. In the Worcester-Millbury-Grafton project segment, the right-of-

way is severely constrained, with ledge cuts, embankment slopes, high-voltage utility poles, and, in a few cases, bridge abutments extending to the edge of the existing tracks. Substantial modifications at crossing bridges will be required at Plantation Street, Hamilton Street, and Sunderland Road, and all fourteen crossing culverts will require lengthening, modifications, and possibly replacement.

The proposed track improvements along the Worcester-Millbury-Grafton segment would involve the following:

- The Putnam Lane Bridge, which extends under the railroad, may require strengthening to accommodate the additional track and train loads.
- Ledge excavation will be required at the overhead Plantation Street Bridge to accommodate the track addition.
- Modifications at the overhead Hamilton Street Bridge will involve either: ledge excavation, relocation of the west bridge abutment by 10 feet, and superstructure and wingwall replacement (Option 1) or realignment of all three tracks through this section and ledge excavation (Option 2).
- Modifications at the Sunderland Road Bridge will involve widening on the east side of the existing undergrade bridge and realignments of all three tracks to accommodate the track addition on the east side. The track addition on the east side is proposed, due to inadequate vertical clearance on the west side of the bridge. This track realignment would also accommodate the additional track further south on the available east bay of the U.S. Route 20 Bridge. Another option to be considered at Sunderland Road would be to lower the roadway profile.
- Extensive ledge excavation will be required to accommodate the track addition on the south side, as ledge adjoins significant portions of the rail corridor. It is anticipated that the ledge excavation would account for approximately $9.8 million of the total costs along this project segment.
- Thirty-two retaining walls are shown in this report to avoid to the maximum extent possible property and environmental impacts along the Worcester-Millbury-Grafton segment. Retaining walls are the single most expensive item, accounting for approximately $19.1 million. Since a conservative approach was taken in this study to location of retaining walls, it is recommended that further design reevaluate the need for retaining walls vs. property takings, based on the current use and type of property affected. Additional property takings that do not impair the current use of the property may result in substantial cost savings for retaining wall construction, but may also result in additional impacts and regulatory and permitting requirements.
- Extensive utilities relocations will be required. There is a high-voltage transmission system operated by National Grid that adjoins a substantial portion of the corridor. It is anticipated that either 39 or 45 of these high-voltage utility poles would be relocated, at an estimated cost of approximately $4.9 to $5.6 million, respectively. Approximately 1,750 feet of the fiber optic system (owned by Sprint) will be affected by track improvements. The affected lines could be relocated, or, alternatively, a spare, empty conduit installed alongside potentially affected areas. CSX utility agreements will need to be researched to determine the responsible party for the costs of this relocation.
- The retaining wall construction will minimize property impacts, but this construction will also affect approximately 5,800 square feet of property within four parcels that consist either of industrial property or undevelopable land adjoining the railroad (ledge). These property takings involve strip takings and will not affect the current or future use of the properties. Installation of the walls will also require temporary easements on a number of properties.
- Retaining walls will minimize wetland impacts, but permanent alterations are anticipated to approximately 4,700 square feet of bordering vegetated wetland and approximately 300 square feet of isolated wetland. Temporary impacts to approximately 315 square feet will occur with retaining wall construction. Permanent impacts will be mitigated through creation of wetlands replication areas. Permitting is anticipated to include a Notice of Intent under the Massachusetts Wetlands Protection Act and a U.S. Army Corps of Engineers Programmatic General Permit (Category 2, reporting).
- Work will occur adjacent to an Estimated Habitat for a state-threatened species at the Perkins Farm Conservation Area. This will require review by the Massachusetts Natural Heritage and Endangered Species Program in accordance with the Massachusetts Endangered Species Act. No permanent alterations to this conservation property will occur due to a proposed retaining wall, but retaining wall installation may incur temporary impacts.
- The total cost of this project segment is estimated to be approximately $61.4 million.

In addition to the CSX proposed track improvements evaluated under the current study for the Worcester-Millbury-Grafton project segment, several other options have been identified for further consideration, given the substantial cost and extent of infrastructure modifications required (to bridges, retaining walls, ledge, utilities, culverts) to accommodate the track improvements. These other options are as follows:

- **Option to Terminate Yard Lead 6,000 feet East of Worcester Yard:** Although extending the third track all the way to CP39 would allow CSX freight trains to clear the main line sooner, it would be a very expensive arrangement and would involve considerable impacts. An option to consider would be to reduce the amount of track extension by terminating the track extension approximately 6,000 feet east of the yard. This is based on the minimum track length to accommodate CSX staging and assembling of trains from Worcester Yard, which would be equal to doubling of the longest track in the yard. Most of the ledge impacts occur in this section of track, so substantial rock excavation and retaining wall construction would still be required. Eliminating CP39 and creating an interlocking at CP42 could further improve this arrangement.
- **Options West of Worcester Yard:** Options west of Worcester Yard may provide improvements in CSX freight service at substantially lower costs. An example of improvements might include track lead extensions at the west end of the CSX Worcester Yard. These options could be implemented in addition to, or in lieu of, improvements to the Worcester Yard lead.

Recommendations

It is recommended that the Ashland-Framingham and Worcester-Millbury-Grafton project segments be advanced as separate and independent projects in a two-pronged approach, given the complexity of the issues in the Worcester-Millbury-Grafton segment. These projects have independent utility and can be designed, permitted, and developed separately. This approach is recommended based on the longer lead time for development of designs, the extent of modifications required, and coordination needed to advance the Worcester-Millbury-Grafton portion of the project. Planning and design for the Worcester-Millbury-Grafton segment will require coordination with MassHighway for bridge modifications, the utility companies for major utility relocations, and affected property owners for installation of retaining walls. Development of this project segment will also require additional geotechnical investigations for ledge cuts and retaining walls. Moreover, further consideration of other design options identified in this report (Option to terminate yard lead 6,000 feet east of Worcester Yard and Options west of Worcester Yard) for the Worcester-Millbury-Grafton section may be warranted, since the service level benefits associated with the longer track extension to CP39 may not justify the considerable costs and impacts involved.

Coordination with CSX is needed to gain concurrence on assumptions made in this study regarding the conceptual designs for the track improvements (including use of 13-foot track center spacing) and other options identified for further consideration. Ultimately, agreement with CSX will be needed as far as the type of track improvement proposed and the number of additional trains that could be accommodated with the proposed track improvements.

Worcester Commuter Rail Service Improvements
Conceptual Design Report

1. Introduction

This feasibility study was initiated to examine the potential for service improvements on the Framingham/Worcester commuter rail line, which extends from South Station in Boston to Union Station in downtown Worcester. The line currently accommodates Massachusetts Bay Transportation Authority (MBTA) commuter rail service, Amtrak inter-city, and CSX Transportation freight operations. CSX refers to this line as its Boston & Albany line.

This study examines the potential for constructing an additional third track alongside segments of the existing two tracks of the MBTA Framingham/Worcester Line to provide better segregation of MBTA commuter rail service and CSX freight operations. An additional track extending from CSX freight yards in Worcester (east of Worcester Yard) and Framingham (west of Nevins Yard) would increase operating capacity for MBTA and Amtrak passenger service, as well as for freight service, and would allow for more frequent headways for commuter trains.

The project is more specifically defined as the alternatives analysis for the addition of approximately 6.5 miles of controlled siding track in the Framingham and Worcester areas. The genesis of the study is a CSX Transportation study, the *MBTA Worcester Service Study* (July 2003). This study outlined to the MBTA the capital improvements on the Worcester Line that would be necessary to increase MBTA commuter, Amtrak Inter-city, and allow for expansion of CSX freight service on the line for the year 2010.

The MBTA Program for Mass Transportation (PMT) is a central element used by the MBTA for capital planning. Operation of more frequent service between Framingham and Worcester is identified as a High Priority Service Enhancement project as part of the PMT.

2. Project Context

2.1. History of Commuter Rail Service

The Framingham/Worcester Line extends 44 miles between Boston and Worcester. This rail line provides service from South Station to the eight other communities along the line in MetroWest area and Central Massachusetts. Existing stations provide stops in Newton, Wellesley, Natick, Framingham, Ashland, Southborough, Westborough, Grafton, and Worcester.

This line, known as the Boston & Albany Line, was one of the very early passenger rail lines in New England and commenced service in 1835. Declines in passenger service over the years led to suspension of service to Worcester in 1975, although service to Framingham continued.

In 1994, service to Worcester was reinstituted due to growing demand for passenger rail service between the two largest cities in Massachusetts. This extension of rail service from Framingham to Worcester represents the only MBTA service on a rail line that is not owned by a government agency. The Framingham/Worcester Line is the MBTA's second longest passenger service line. This resumption of service was accomplished by the addition of a second track between Framingham and Worcester. This project also included operational and signal upgrades as well as the construction of four new stations at Ashland, Southborough, Westborough, and Grafton, and the rehabilitation and reopening of Union Station in Worcester.

Ridership increases on the Framingham/Worcester Line over the past five years have been significant, with most of the growth in recent years at newer western stations. Over the next decade MBTA ridership is forecasted to increase by 50%, according to the results of the *Draft Final Report on the Worcester Service Expansion Study* (March 2003), prepared by KKO and Associates, LLC for the MBTA.

Worcester community officials have pursued further improvements in passenger service. The City of Worcester is interested in making Worcester a regional destination for rail passengers.

2.2. CSX Operational History

The Framingham/Worcester Line is the most frequently used freight line in New England. CSX Transportation, Inc. currently owns the 23 miles of track between Framingham and Worcester. CSX maintains, dispatches, and operates freight service along the Boston and Albany Line, accommodating intrastate and interstate shipments. CSX services include accommodating the MBTA and Amtrak service which also operates over the line.

In 1994, CSX allowed the MBTA to extend service from Framingham to Worcester with an initial six trains per day and then in 2001 the service further expanded to twenty trains per day. According to the CSX report, this was accomplished in three phases (Phase I – III) through the addition of ten miles of a second main track and three crossovers. These crossovers provide control points for switching of trains between tracks and were located at Control Points (CPs) 33 in Westborough, 39 in Grafton, and 43 in Worcester. The last two phases (Phases IV and V), consisting of the addition of two universal crossovers and Cab signaling (signalization within the locomotive/control car) between Framingham and Boston, has not been completed, however, universal crossovers were installed at CP24 in Ashland and CP28 in Southborough.

The MBTA then requested further expansion of service beyond the existing agreements. The MBTA authorized CSX to perform a capacity study in February 2003. That study discussed the inherent problems in modeling complex areas and this project was certainly complex. Part of that complexity is the difficulty in modeling working yards from main tracks. As CSX stated in their study, this requires

building (or planning for) capacity beyond model predictions as a safety factor to provide more reliable predictions of future growth in freight movements.

2.3. Amtrak Inter-City Passenger Service

Amtrak currently operates the Lake Shore Limited service between Boston and Chicago on the Boston & Albany Line extending roughly 200 miles from Boston on a direct service route that extends west to Albany (Rensselaer), New York, where the train is combined with the New York City section. This line services stops in South Station, Back Bay, Framingham, Worcester, and Springfield. From Albany, connecting transfers are available on the Lake Shore Limited route to destinations as far west as Chicago, Illinois, with stops in upstate New York, Pennsylvania, Ohio, Indiana. From Albany, Amtrak also provides service on the same route from Chicago south to New York City. This route was formerly operated by the New York Central Railroad, with service between Toledo, Ohio and Chicago.

3. Current Study

The current study for the Worcester Commuter Rail Service Improvements was initiated in November 2003. Initial consideration was given to adding a third track along the entire 23 miles of the project. This, along with other significant capacity improvements, would be necessary to mitigate service disruptions to accommodate the CSX 2010 plan.

Prior to the commencement of the study, the scope of the study was changed to concentrate on the installation of 6.5 miles of new third track extensions at the east end of Worcester Yard and the west end of Nevins Yard in Framingham. This approach would be consistent with the CSX study. The CSX study indicates that this is the minimum amount of track improvements that would be necessary in order to add mid-day commuter trains to the existing MBTA schedule. According to the CSX study, these improvements would allow the MBTA to add four mid-day trains (two round trips). It is not clear from the CSX Study how many, if any, beyond the four additional trains could be added by the MBTA after year 2010.

Prior to the initiation of the study, it became clear that service improvements could be obtained with track additions at key junctures in the line, where freight trains are assembled at the CSX rail yards. Assembling freight rail cars in consists of 1 mile or more in length requires that trains occupy the yard leads and 1 mile of track leading into the yards, for periods of 1 to 2 hours or more. Track additions at these key junctures (along 6.5 miles) could result in substantial service improvements, without addition of track along the remaining 16.5 miles of the line extending through portions of Grafton, Westborough, Southborough, and Ashland.

Moreover, addition of a third track along the remaining 16.5 miles of the line would involve constructing a third track through both the Westborough Cedar Swamp Area of Critical Environmental Concern and the Grafton State Hospital National Register District. This third track would also require major modifications to recently constructed commuter rail stations at Ashland, Southborough, Westborough and Grafton. Potential improvements and issues along key portions of the Framingham/Worcester Line tracks that were identified early in the study and that would need to be addressed for triple tracking along the entire 23 miles of track between Framingham and Worcester are outlined in Table A-1. The service level improvements that would be provided with these track improvements are not commensurate with the substantial costs and environmental impacts that would be involved. Limited track additions along portions of the line would provide considerable service improvements while significantly lowering costs and reducing impacts.

The focus for the current study is on the 6.5 miles of track along two segments: a 1.7-mile section extending from Nevins Yard in Framingham west to Control Point (CP) 24 in Ashland and a 4.3-mile section extending east from Worcester Yard in Worcester through Millbury to CP39 in Grafton. The third track additions in these areas correspond to the location of the critical yard leads to Nevins Yard in Framingham and Worcester Yard and the nearest operational control points for switching trains, CP39 in Grafton and CP24 in Ashland. The tracks would be located entirely within the CSX right-of-way, with some takings/easements possible due to infrastructure modifications. The Worcester section also contains an additional 0.5-mile of track within Worcester Yard that would extend the freight lead east.

The third track extension west out of Nevins yard allows trains to work Nevins yard without occupying the main track. The east extension of the Worcester East end yard lead allows intermodal trains to work clear of Main Line Track 2, while the extension of the freight lead eastward allows trains to make simultaneous moves to/from the intermodal yard. A further discussion of CSX freight operations is contained in the section entitled *Freight Operations*.

4. Scope of Investigations

This report presents the results of studies performed to determine the feasibility of track additions along the Ashland-Framingham and Worcester-Millbury-Grafton segments of the line. A separate but parallel study as part of the same project evaluated the feasibility of extending commuter rail service on a spur that branches off of the Framingham/Worcester Line just east of Framingham Station. This study evaluated extending commuter rail service along the Fitchburg-Secondary Line north to a new station and parking facility on Framingham State College campus.

The public involvement conducted for the project addressed both components of the project, the Worcester Service Improvements and the Framingham State College Commuter Rail Station Feasibility Study. Two public informational meetings and two stakeholder meetings were held in June and July of 2004 in Framingham and Worcester, and two public meetings in each community were held in May of 2006. The purpose of these meetings was to obtain public input into the study process and to keep the public informed on the progress of the study. In these meetings, community representatives and the public expressed a strong belief that there is demand to support increased service to Worcester and other stations west of Framingham.

The study included coordination with CSX on freight operations, and site inspections of the track were performed to evaluate track conditions and identify environmental constraints. Field walkovers of the Framingham/Worcester Line were performed on September 13, 2005 and on October 18, 2005. During the field walkover, a review of the conditions of the track, overhead or undergrade bridges were performed, and proximity to adjoining properties and environmental conditions were noted. In addition, information available from MassGIS, regulatory agencies, and other sources were compiled and reviewed. Based on the initial field observations and information gathering, wetlands investigations downslope of the track were also performed at key locations as part of a separate field reconnaissance.

This report presents the results of these investigations.

5. Existing Conditions

5.1. Existing MBTA Commuter Rail Operations

The Framingham/Worcester Line between Framingham and Worcester was expanded to a two-track system as part of the Worcester Commuter Rail Extension Project. The Framingham/Worcester commuter rail line is generally a 60 mph double-track railroad with a sophisticated signal system which allows trains to operate on either track in either direction. A series of crossovers at interlockings or control points, allows trains to run around slower trains or around maintenance work on sections of track. The track structure is generally in good to excellent condition. Track 1 (on the north) typically accommodates westbound trains, and Track 2 (on the south) accommodates eastbound trains. The route is currently utilized by MBTA for the movement of 40 daily passenger trains (20 round trips) operating between Framingham and Boston. Of these trains, 20 trains (10 round trips) continue on to provide service to Worcester. In stakeholder/public meetings and in general, it is believed that there is demand for more service and with the addition of mid-day trains that demand would increase further due to the added flexibility it gives commuters to "escape" during mid-day hours.

During weekdays, service inbound to Boston from Worcester operates on headways of 30 to 40 minutes during the peak period in the peak direction (inbound in the AM peak period), as shown below. Inbound service includes a gap in the morning (between 8:16 AM and 10:31 AM). Headways for inbound service for the remainder of the day are every two to three hours during the mid-day and extending through the afternoon-evening peak period (non-peak direction).

In contrast, during peak hours, Framingham inbound service operates on headways of every 13 to 35 minutes, and off-peak inbound service operates on headways of between 45 and 105 minutes until 8:15 PM.

Framingham/Worcester Line Inbound Worcester to Boston Service Schedule Worcester Departure Times					
Inbound Peak	6:06 AM	6:38 AM	7:07 AM	7:37 AM	8:16 AM
Inbound Off-peak	10:31 AM	2:00 PM	5:38 PM	7:40 PM	11:40 PM

Service outbound includes a gap from South Station (between 7:35 AM and 9 AM) in the morning peak, and two to three trains per hour during the evening peak outbound to Framingham, with less frequent service to Worcester (5:23 PM, 6:11 PM, 6:59 PM, and 7:18 PM).

In the outbound direction from South Station, off-peak operations to Worcester operate on headways of 3 to 4 hours during the morning and mid-day, and 1 to 2 hours in the evening off-peak. This compares to off-peak service to Framingham on headways of 1 to 2 hours throughout most of the day.

Framingham/Worcester Line Outbound Boston to Worcester Service Schedule Worcester Arrival Times				
Outbound Off-Peak (AM-Midday)	8:01 AM	10:17 AM	1:26 PM	---
Outbound Peak	5:23 PM	6:11 PM	6:59 PM	7:18 PM
Evening Off-peak	8:40 PM	9:43 PM	11:28 PM	----

5.2. CSX Freight Operations

This section addresses the present freight operations and general layout at Framingham and Worcester and how operations may be impacted by the proposed track improvements. In general, the changes involve extending the yard lead tracks for freight operations. The net effect will be that operations would appear the same to the casual observer; that is, freight trains will continue to stop, move back and forth while processing cars from one track to another as they drop and pick up cars and switch the yards.

However, the extension of the lead tracks will allow the freight trains to switch cars without occupying the Main Line, thus improving the train handling capacity of the route, allowing more passenger trains to be moved, with less delay to all trains.

Both Framingham and Worcester have active rail freight operations and facilities that will remain active in some form for the foreseeable future. In addition, there is a currently inactive automobile unloading facility and active adjacent liquid sweetener distributor located near Milepost 33 in Westborough. There are also a small number of individual carload consignees with private sidings at various locations between Framingham and Worcester and one consignee between Framingham and Boston located on the Saxonville Industrial Track. That track connects to the Main Line at Natick.

5.2.1. Framingham

Framingham functions as CSX's regional distribution and assembly point for most freight carload (non-intermodal) rail traffic in Eastern Massachusetts. Approximately 35,000 carloads of freight per year are processed through Framingham. A major railcar automobile unloading facility is located about 1 mile south of the Main Line in Framingham. That facility used to process over 10,000 cars annually. Since the opening by CSX of a new facility in Spencer/East Brookfield, only 2,500 rail cars are handled at Framingham, and none are currently processed at Westborough.

There are a total of four yards at Framingham, three of which are active. In addition, to the main east-west line between Boston and Worcester, there are three connecting rail lines: one to the north and two rail lines diverging south. There are a total of three interlockings, or designated control points (CPs), where the rail lines intersect:

- CP23 to the west that simply ties the west end of the freight facilities to the Main Line;
- CP22 that provides a universal crossover on the Main Line, provides the connection to the Holliston Secondary, defines the east end of Nevins Yard and the West Wye and connection to the North Yard; and
- CP21 located east of the MBTA station that connects the East Wye to Track 1, universal crossovers on the Main Line, and the connection of the Framingham Secondary to Track 2.

5.2.1.1. Yards at Framingham

The yards include Nevins Yard, North Yard, the Auto Yard and CP Yard.

- **Nevins Yard** is located along the north side of the east-west Main Line west of the MBTA Framingham Station in downtown Framingham. Nevins consists of six tracks ranging from 2,200 feet to 1,600 feet in clear length. Nevins Yard is primarily used for picking up and setting off cars by the Main Line freight trains and as an overflow if the North Yard is jammed. Nevins Yard is connected to the North Yard from its east end, around the west leg of the wye near the passenger station and then to the north along the Fitchburg Secondary track. To the west of Nevins Yard, there is a lead track, known as the Third Iron, on the north side of the Main Line that connects back to the Main Line at CP23 west of Framingham. Another track (the Fourth Iron) parallels the Main Line to the south and extends from the east end of Nevins Yard west to CP23. The Third Iron west lead of Nevins Yard is long enough to pull the longest train in the yard west out of the yard and stay clear of the Main Line at CP23, but, in total, is not long enough to accommodate a train much over 4,000 feet in length. In many instances, a train making drops and pick-ups at Nevins must occupy the Main Line while accessing the yard via the interlockings at each end (CP23 and CP22).
- **North Yard** is located between the Fitchburg Secondary Line and the Main Line north of the MBTA station. This yard is the primary freight yard at Framingham and is where the four local freights operating on a typical day are made up. CSX maintains a yard office and crew facility at the south end of the yard. Operations in North Yard are described under the *Fitchburg Secondary Line* below.
- **Auto Yard** is located about 1 mile south of the Main Line on the Holliston Secondary Line. This yard consists of four double-ended tracks plus a through or running track. The four unloading tracks can each hold 12 of the 90-foot-long automobile rack cars, although normally only 10 cars in two groups of five are spotted for unloading.
- **CP Yard** is located south of the Auto Yard on the Holliston Secondary Line. This yard formerly functioned as the support yard for the large General Motors assembly plant east of the Holliston Secondary Line. This plant currently is not an assembly plant and is used as a large used car wholesale operation. The CP Yard is used only for rail car storage on occasion. The Holliston Secondary is out of service south of the CP Yard

5.2.1.2. Fitchburg Secondary Line

The rail line to the north, the Fitchburg Secondary Line, connects to the east-west Main Line at a full wye, bracketing the MBTA Framingham passenger station. At the north end of the wye is the North Yard, a 16-track, double ended yard with tracks ranging from about 1,800 feet to 900 feet in clear length. This yard is along and just east of Farm Pond. This rail route heads north and west past Framingham State College and continues about 30.5 miles to Leominster. There are a number of on-line freight consignees along this route served by a five day per week local freight that originates at and returns to Framingham's North Yard. The line used to go all the way to Fitchburg (another 4.5 miles beyond Leominster) where connection was made with the Boston & Maine (now Guilford) Railroad. This segment has not been used for at least 10 years and has been obliterated in several sections. The North Yard is mostly switched from the north end. The local freights in and out of Framingham are made up in this yard. It is anticipated that freight operations at North Yard Framingham and the Fitchburg Secondary Line will stay more or less the same in the foreseeable future. The primary change could be the addition of some number of MBTA passenger trains using the east leg of the wye track to and from the Main Line towards Boston and passing through one side of the yard and on to the State College. Some track modifications at each end of the yard and some type of signal system would be required for passenger operations. Overall freight operations in the North Yard will be minimally impacted by these modifications.

5.2.1.3. Holliston Secondary Line

The Holliston Secondary Line diverges south from Track 2 (inbound main) just west of the Framingham MBTA Station, crosses Waverly Street (Route 135) at grade and several local streets (Clafflin, Hollis and Waushakum Streets) to access the Auto Yard, about 1 mile to the south. This yard is accessed daily by the unit auto train Q264/Q283. [That train also serviced the auto yard at Westborough.] CSX has constructed a new auto unloading facility in East Brookfield, MA. As a result, current auto unloading activities at Westborough have ceased, and Framingham activities have been curtailed. It is possible that some other type of rail operation may occur at these two facilities in the future, but the exact use and disposition is not known at this time.

5.2.1.4. Framingham Secondary Line

The Framingham Secondary Line diverges south from Track 2 (inbound main) at CP21 just east of the Concord Street grade crossing. This line goes generally southeast, crossing the MBTA's Franklin Branch at Walpole and then intersecting the Northeast Corridor at Mansfield, about 21 miles from Framingham. This line sees several local freights per day that ferry cars to and from Framingham and all points south of Boston and Eastern Massachusetts on CSX and the Bay Colony Railroad. Trains from the North Yard use the east leg of the wye and the crossover east of Concord Street (CP21) to access the Framingham Secondary Line. About four train movements per day (two in each direction) use this route. It is anticipated that this operation will remain unchanged.

5.2.1.5. Main Line

The Boston & Albany Line, also referred to as the Main Line, is double track throughout with reverse signaling, allowing trains to use either tracks for eastbound or westbound service.

- **CP21:** East of Framingham is CP21, which consists of universal Number 15 (angle of 1:15) crossovers from Track 1 to 2 and the diverging route south for the Framingham Secondary Line. These elements are located just east of the Route 126 (Concord Street) grade crossing. Just west of the Route 126 crossing is an interlocked Number 10 righthand turnout that connects the east leg of the wye. The East Wye leads to the North Yard.

- **CP22:** West of the MBTA Framingham Station is CP22. This interlocking consists of:
  - the Number 10 righthand turnout from Track 2 for the Holliston Secondary Line,
  - a set of universal crossovers for the Main Line,
  - a connection from Track 1 to the west leg of the wye and
  - subsequent connection to the east lead of Nevins Yard and to the North Yard, and
  - a righthand crossover between Track 1 and the parallel east lead of Nevins Yard.

  That lead provides a direct route between Nevins Yard and the North Yard without having to enter the Main Line. There is also an interlocked turnout at the east end of the Fourth Iron, the parallel track south of the Main Line between CP22 and west to CP23. West of Nevins Yard, the 3rd Iron functions as the west lead.

- **CP23:** The Third Iron track extends about 3,000 feet west of the yard and ends at a connection to Main Line Track 1 at CP23. The Fourth Iron track south of the Main Line also ties back to Main Line 2 at CP23.

5.2.1.6. Freight Operations

In addition to the MBTA's passenger operation and Amtrak's Trains 448 and 449 (the Boston Section of the Lake Shore Limited), the Boston Line is used by a number of CSX local and through freight trains. The through freight trains can be divided into three types: the intermodal trains, the general or mixed freight and the automotive trains. These train types are generally as follows:

Intermodal Trains

The intermodal trains, which carry freight containers and trailers for loading or off-loading by trucks, run between Beacon Park Yard in Boston and various points on the CSX system. Approximately 48,000 units (individual containers and trailers) per year are handled to and from Boston annually. Depending on the day of the week and general traffic conditions, the number of trains and their length vary considerably from day to day. Based on six day per week operation, the average total length of intermodal train in each direction to and from Boston would be just over 4,000 feet. These trains do not work at Framingham and normally pass through without stopping unless delayed for some reason. There are normally three to five intermodal trains in each direction through Framingham. These trains and their approximate times at Framingham are:

Westbound	Eastbound
Q113 - 1:30 AM	Q114 – 6:30 AM
Q115 – 8:30 PM	Q116 – 3:30 PM
Q117 – 9:30 PM	Q140 – 6:00 AM
Q119 – 3:30 AM	Q168 – Noon
Q167 – 11:00 PM	Q174 – 12:15 PM

Trains Q167, 168 and 174 normally terminate/originate their trains in Worcester and often run just light engines (locomotives only) into Boston to service the power (locomotives) at the Beacon Park facility since Worcester does not have service facilities. The intermodal trains typically run only five or six days

per week (Q114 is daily), and some change schedule somewhat on the off day and are designated with the prefix "L" rather than "Q" on those days.

Mixed Freight

There are at least two pairs of mixed freights that work at Framingham. These trains handle the non-intermodal, general carload traffic moving to and from the various lines and industries. These trains and their approximate times at Framingham are:

Westbound	Eastbound
Q421 – 2:00 AM	Q420 – Midnight - Selkirk, NY to and from Boston
Q423 – 1:00 PM	Q436 – 8:45 PM - Selkirk, NY to and from Framingham

These trains normally drop and pick up cars from Nevins Yard, although the Q423/436 sometimes terminates and originates in North Yard. The Boston general freight Q421/420 handles about 12,000 carloads per year in and out of Boston, in addition to what is handled at Framingham. The largest single group of Boston cars is sealed containers of municipal solid waste loaded at Beacon Park Yard, which accounts for about 5,800 carloads per year. Recently, CSX began moving the solid waste in a separate train designated K295.

In addition, a Q425/422 will run in and out of Framingham as required by peaks in traffic volumes at both Worcester and Framingham.

Based on 365 day per year operation, the mixed freight trains serving Boston and Framingham average a total of about 120 cars per day in each direction west of Framingham with a total average length of less than 8,000 feet.

Automotive Trains

Automotive trains and their approximate times at Framingham are:

Westbound	Eastbound
Q283 – 4:30 AM	Q264 - 4:30 PM

Often, the power (locomotives) run light (locomotives only) into Boston for service. These trains also work at the Westborough facility.

Local Freights

There are a number of local freight trains that operate in and around Framingham on the Main Line and the various secondary lines that diverge in three other directions. The number of and working limits of the local freights change as required to meet operational requirements and in response to continuing efforts to provide adequate service with the least cost. In general, the local freights working in and around Framingham are as follows:

- **B722** (Mon–Fri), on duty Framingham 2:00 PM, works west on Main Line and return about 10:30 PM.
- **B723** (Thurs-Mon), on duty Framingham at noon, works west on Main Line to Worcester and returns about 7:30 PM.
- **B724** (Mon-Fri), on duty at 10:00 AM works north on Fitchburg Secondary to Leominster and returns about 6:30 PM.
- **B725** (Sun-Thurs), on duty at midnight, works south on Framingham Secondary to Attleboro delivering cars to Southeastern Mass, picks up outbound cars from another train at Attleboro and returns about 8:00 AM.
- **B731** (Mon-Fri), on duty in Readville at 11:00 PM, bringing cars to Framingham, arriving about 6:00 AM, leaving about 7:00 AM and return to Readville about 9:00 AM.

The B722 and B723 also do yard switching at Framingham, transferring cars between Nevins Yard and North Yard, making up blocks of cars for pick-up by the through freights and making up the trains ferrying cars to other locations.

5.2.2. Worcester

For CSX, Worcester functions as a very busy intermodal terminal having:

- UPS as the major customer,
- a bulk transfer facility with 102 car spots for mostly plastic resin transfer to trucks,
- a major interchange with the Providence and Worcester Railroad for both intermodal and carload traffic and
- an interchange point with Guilford Rail System.

Except for the bulk transfer facility (TransFlo in CSX parlance), there is little carload traffic (non-intermodal) at Worcester for CSX, only that which goes on to either the Providence & Worcester (P&W) Railroad or Guilford Railroad.

The CSX Yard at Worcester is physically constrained both laterally (side to side) and longitudinally. The other major impediment to efficient freight operation is the physical arrangement and track configuration to and from the P&W facilities at CP45. In essence, all traffic on CSX going to and from the P&W must use the limited track area at Worcester east of the P&W connection and change direction and head back west to access the P&W. The P&W connection is also on the opposite side of the Main Line (north side) from the yard requiring that transfer moves to and from the P&W often need to cross over both main tracks.

As a result of the physical constraints, Main Line Track 2 (eastbound in normal righthand running) is almost exclusively used by CSX for various intermodal trains dropping and picking up in the intermodal yard and for transfers of cars to and from the P&W. This forces most of the MBTA commuter trains to be limited to use of just Track 1 between Union Station at Worcester and the existing righthand crossover interlocking located at Milepost 39 (CP39), almost five miles east of Union Station. The MBTA's Worcester Layover Facility is accessed off of the Station Track situated east of Union Station and in turn connected to Main Line Track 1. This arrangement places additional operational pressure on Track 1, further exacerbated by the single station platform at Worcester.

5.2.2.1. Main Line

The Main Line is double track with reverse signaling throughout and there are three interlockings within the limits of Worcester and a fourth to the east that is involved.

- **CP45:** The most westerly interlocking is CP45. This is located just west of Union Station and consists of:
  - a universal crossover between the Main Line tracks,
  - the westward-facing connection to the Providence and Worcester (P&W) from Track 1,
  - the eastward-facing connection to the combined P&W Gardner Branch and Guilford WN&P route to Ayer from Track 1,
  - the eastward facing connection to the passenger track at Union Station from Track 1, and
  - the eastward facing connection to the west end of the CSX Worcester Yard from Track 2.

  There is also a long storage track south of Track 2 to the west that has its eastern end a short distance west of the connection to the yard.

- **CP44:** This interlocking is at the eastern third of the yard area and consists of a righthand crossover connection between the Station Track on the north side to Track 1 and a second righthand crossover to the east connecting Track 1 to Track 2. The intent of this interlocking is to allow MBTA and Amtrak trains access to either the Main Line track to the east or access to the single platform at Union Station to the west. The MBTA layover facility (four tracks) also connects to the station track just west of the crossover between the Station Track and Track 1. As noted below, full function of this interlocking is not always possible due to the need for CSX trains to occupy Main Line Track 2 east of CP44. This use of Main Line Track 2 by CSX effectively limits the MBTA to single track operation for five miles between Union Station and CP39, the location of the next righthand crossover.

- **CP43:** This interlocking marks the east end of Worcester Yard. It consists of a single Number 10 turnout connecting the Thoroughfare Track of the CSX yard to Main Line Track 2 and then a lefthand Number 20 (angle of 1:20) crossover between Main Line Track 2 and Main Line Track 1.

- **CP39:** CP39 is located almost five miles east near the Millbury/Grafton town line, behind the Wyman Gordon Industrial Area. This interlocking is simply a single righthand crossover. Due to congestion at Worcester and the need for CSX to use Main Line Track 2 for most periods of the day as described below, this interlocking is used by most MBTA and Amtrak trains, crossing them over to Main Line Track 1 all the way to Worcester.

5.2.2.2. Freight Operations

Worcester Yard

The west end of CSX's yard starts at CP45 where I-290 crosses overhead. The track closest to Main Line Track 2 is the "Thoroughfare", the longest track in the yard with a clear length of about 4,400 feet without fouling the other tracks at the east end of the yard and about 5,800 feet without fouling Main Line Track 2 at CP43, the extreme east end of the yard. The next track to the south is Track 34. This track provides a clear length of about 3,900 feet without fouling the east end of the yard and only 3,175 feet without fouling the west end of the yard. The next tracks to the south are the two intermodal ramp tracks and then the TransFlo (bulk transfer) area, consisting of a number of shorter stub end tracks. These tracks connect to lead tracks to the east where the yard narrows, confined by a steep hillside to the south.

Eastbound intermodal trains dropping cars or terminating at Worcester have a number of options, depending on which tracks are clear. If both intermodal tracks are clear, these trains simply pull in from CP45 to the Thoroughfare and then Track 34 to the north of the two intermodal ramp tracks, until the west end is clear, cut the train, pull forward and then shove back into the second ramp track. If there are cars on the intermodal tracks, these trains may stay on either the Thoroughfare or Track 34, using one or the other or both tracks, depending on train length and if there already are cars on either of those tracks. Often, the only choice is to either hold the train out on the long storage track west of the yard or use Main Line Track 2. CSX sees a volume of about 115,000 intermodal units per year at Worcester, almost all in the form of single-level containers and trailers. On a six day per week basis, this translates into about 11,000 feet of intermodal train per day in each direction. With only 5,850 foot of ramp track (unloading track) available, the ramp tracks have to be "turned" (unloaded, loaded and train removed) twice per day.

Providence & Worcester (P&W) Interchange Traffic

In addition to their own intermodal trains, CSX delivers cars to and from the P&W using the limited track capacity available at Worcester. Typically, about 19,000 carloads of general freight (38,000 cars loaded and empty) per year are handled through Worcester to the P&W and about 75,000 intermodal units per year, mostly double-stacked international containers. That amounts to an average of 61 cars per day in each direction for the general freight, and a little over 100 intermodal cars per day in each direction, based on operation six days per week. That translates into about 3,600 feet of general freight and about 6,000 feet of intermodal train daily in each direction. All the P&W cars come and go to the west on CSX and have to be reversed in direction at Worcester east of CP45 and then moved to or from the P&W connection. These movements combined with the CSX intermodal trains place considerable pressure on the three tracks available east of CP45: Main Line Track 2, The Thoroughfare and Track 34. Due to the limited length of Worcester Yard, it is often necessary for trains to extend on Main Line Track 2 east of CP43. There is also limited lead or tail track on either end of the yard. Often, Main Line Track 2 has to be used as the switching lead.

Guilford Interchange Traffic

The Guilford Interchange at Worcester amounts to about 28,000 carloads per year that includes the automotive traffic to Guilford's automobile unloading facility at Ayer and general freight to and from Maine, New Hampshire, and northeastern Massachusetts. This traffic is handled via CSX trains Q426/Q427. This pair of trains operates to and from Selkirk, NY to CP45 at Worcester where it takes the direct connection left and north towards Ayer. A second pair of trains (Q274/Q293) operates several days per week from Springfield to Ayer and return to Springfield with one crew. That train handles just automobile traffic when volumes are greater than the Q426/Q427 can handle. The first three miles of the route north from Worcester is owned by P&W and used to access their Gardner Branch that diverges at a junction point known on the railroad as "Barber Station". At that location, the track towards Ayer is owned by Guilford and the train is turned over to Guilford and recrewed with a Guilford crew at that location. The same operation occurs in reverse for the westbound train. Since the connection to the Boston Line at Worcester allows a continuous movement in the same direction west of the yard and station, this rail traffic has minimal interference with overall operations at Worcester.

5.3. Amtrak Inter-City Operations

Amtrak service on the Lake Shore Limited operates daily, with one daily roundtrip in each direction (outbound to Albany and inbound to Worcester, Framingham, and Boston). The outbound trains depart South Station in Boston at 11:45 AM, with stops in Framingham (12:18 PM) and Worcester (12:48 PM), to arrive at Albany (Rensselaer) at 4:45 PM. The inbound trains leave Albany at 1 PM and arrive at South Station at 6:20 PM, with stops in Worcester (at 4:40 PM) and Framingham (at 5:18 PM).

5.4. Study Area for Track Improvements

The original CSX study defined the need for 6.5 miles of track improvements, including the following:

- 1.7 miles extending west of Nevins Yard in Framingham, near the Ashland town line from CP23, to CP24 in Ashland;
- 4.8 miles, including 0.5 miles of improvements in Worcester Yard and 4.3 miles extending east from Worcester Yard, through Millbury to CP39 in Grafton.

These project segments, and a brief description of the proposed track improvements, are described below. This area for the proposed track improvements defines the areas to be directly altered during construction.

5.4.1. Description of Ashland-Framingham Segment

In the Ashland-Framingham segment, Track 1 (on the north) typically accommodates westbound trains, and Track 2 (on the south) accommodates eastbound trains. With the proposed track improvements, a third track would be added to the south of the existing Main Line two-track system.

The Ashland-Framingham Segment extends from just east of CP23 (at Milepost 22.72), west of Nevins Yard and Framingham Station, to CP24 in Ashland, west of the Main Street grade crossing. On the east end of the project, the improvements would consist of extending the yard lead (Third Iron) from Nevins Yard north of the existing two-track system (Tracks 1 and 2), then shifting the tracks so that, further west, the new track addition would be accommodated on the south side of the tracks. The Third Iron would be extended over a distance of approximately 620 feet, north of Tracks 1 and 2, where the tracks border on Framingham Reservoir No. 2 and extend north of Route 135 (Waverly Street). An option would be to realign the tracks near the reservoir to avoid work at the reservoir's edge. The existing tracks (Tracks 1 and 2) would be realigned over a distance of roughly 1,270 feet, from a point just east of the Framingham-Ashland town line west past the culvert at Milepost 23.10.

This section of track includes, to the east, a bridge over the Framingham Reservoir No. 2 (known as the Sudbury River Bridge at Milepost (MP) 23.54), a newly constructed overhead bridge at Fountain Street (MP 23.67), and a bridge over the Sudbury River (MP 23.83).

Over the majority of this project segment, the tracks would be added on the south side of existing Tracks 1 and 2. This added track would become Track 2, existing Track 2 would become Track 1, and the existing Track 1 would be used as the Third Iron extension from Nevins Yard. In the curve east of the Main Street grade crossing in downtown Ashland, the three tracks would be realigned over a distance of approximately 800 feet to allow the relocated Track 2 to meet existing Track 2 and to realign Track 1 to the location of existing Track 1. There are two options for connecting the freight lead and existing Track 1. Under Option 1, the freight lead, to the north, would meet existing Track 1 at a proposed trailing point Number 20 (1:20) turnout, located approximately 120 feet east of the Main Street grade crossing.

Under Option 2, the realigned freight lead would extend an additional 920 feet to a proposed trailing point Number 20 turnout, extending across Main Street and meeting existing Track 1 roughly 230 feet east of the existing Number 20 crossover at CP24, east of the Cherry Street grade crossing.

5.4.2. Description of Worcester-Millbury-Grafton Segment

In Worcester, improvements are proposed within Worcester Yard, which is located east of I-290 and extends east, from Putnam Lane in Worcester. The track improvements in Worcester Yard would include realigning both the intermodal yard lead, which accommodates freight containers and trailers that will be transported by truck to or from Worcester Yard, and the freight yard lead to the south. The freight yard lead will extend east beyond the proposed crossover from the intermodal yard lead to Track 2. This will allow simultaneous moves from Track 2 to the intermodal yard lead, and from the intermodal yard lead to the freight yard lead. This section of the Worcester Yard extends over Putnam Lane. The third track would be added east of the yard lead, on the south side of the existing track.

This section for the proposed track improvements includes, from northwest to southeast, a bridge under Plantation Street, a bridge under Hamilton Street, a bridge over Sunderland Road, the Sacks Siding (located at the Sack Storage, Inc. facility), and a bridge over Route 20. There is also a siding, south of Sunderland Road and north of Route 20, for the Camosse Masonry Supply Company. North of Sunderland Road, the track additions would be accommodated on the west side of the tracks. At Hamilton Street, the tracks can be accommodated with ledge removal, but another option would be realignment of tracks through this section. Both of the freight sidings (at Sack Storage, Inc. and Camosse Masonry Supply Company) would need to be relocated.

At the Sunderland Road Bridge, the tracks will be realigned to accommodate the track addition on the east end of the bridge structure, and the east end of the bridge would be widened to accommodate the track addition. The track realignment in this area is proposed to reduce vertical clearance issues on Sunderland Road, since the east side of the road under the bridge is at a lower elevation. The other reason for the track realignment in this area is to take advantage of existing curves to start the track shift and use available width on the east side of the Route 20 Bridge located immediately to the south. North of, and over, Sunderland Road, the tracks are realigned over a distance of approximately 440 feet to relocate the added third track, on the west side, to the existing Track 2 location. This realignment would add a relocated Track 1 on the east side of this undergrade bridge. South of the Sunderland Road Bridge, over a distance of approximately 2,300 feet, the track addition would be accommodated on the east side of the existing tracks (as a relocated Track 1), existing Track 1 would be used as Track 2, and the freight lead would be accommodated on the existing Track 2 alignment.

Approximately 860 feet east of the Route 20 Bridge, the tracks would be realigned over a distance of approximately 1,330 feet, through the curve extending into Millbury, to accommodate the track addition on the south side. The eastern end of the project would extend approximately a third of a mile into Grafton at CP39 north of the Wyman-Gordon Industrial Area. The added freight track would terminate at Track 2 at a proposed trailing point Number 20 turnout at CP39, and a proposed Number 20 crossover would be added to the east between Track 1 and Track 2.

5.5. Topography and Geology

5.5.1. Description of Ashland-Framingham Segment

Topography is relatively flat in this project segment. The areas where the third track would be added are either relatively flat or are graded over the majority of this segment. On the east end of this project segment, the tracks extend parallel to, then cross Framingham Reservoir No. 2 (Brackett Reservoir). The rail line also crosses over the Sudbury River just west of the Framingham Reservoir No. 2 crossing.

Grades along the tracks slope gradually in this section. Elevations in this project segment vary from roughly 196 feet NGVD (1929) at Framingham Reservoir No. 2 to 184 feet at the Sudbury River Bridge crossing. Elevations in the downtown Ashland business district, at the west end of this project segment, are at approximately 190 feet.

There are no areas of rock ledge along the Ashland-Framingham segment. This area is underlain by granites and mafic rocks within the Avalon Belt.

5.5.2. Description of Worcester-Millbury-Grafton Segment

There are steep slopes that adjoin the existing track in a number of locations. The tracks gradually slope along this project segment from maximum elevations of roughly 500 feet NGVD (1929) east of Worcester Yard, at the western end of the segment, to minimum elevations of about 400 feet at the east end of this project segment in Grafton at CP39.

More than roughly ½ mile (approximately 3,100 feet) of the existing tracks adjoins areas of rock outcrops or ledge in the area of the proposed track improvements. On the western end of the project, near Worcester Yard, the bedrock geology consists of metamorphic and granitic rocks of the New Hampshire-Maine Sequence. The remainder of the tracks to the south and east are underlain or bordered by metamorphic rocks of the Avalon Belt.

Where there are substantial areas of ledge that adjoin the existing track in the area of the proposed track addition, the tracks are located within a cut section. Rock ledge occurs within the northern half of this project segment. The largest section of ledge surrounds the Plantation Road crossing, extending along the south side of the tracks (where the track would be added) over a distance of approximately 1,800 feet extending from approximately Milepost 43 (west of Tampa Street) south to the area off of Wells Street. The ledge in this section reaches heights of up to 35 feet.

Rock ledge also closely adjoins the west side of the tracks along smaller sections (over lesser distances of between roughly 50 to 400 feet) in the following locations:

- An outcrop off of the industrial complex off of Solferino/Northboro Streets (Milepost 42.46),
- A section of ledge situated at the edge of residential properties off of Marlboro/Franklin Streets (Milepost 42.33-42.4),
- Outcroppings adjoining either side of the Hamilton Street Bridge, on the west side of the tracks (Milepost 41.67),
- Sections of ledge extending several hundred feet north of the Sack Storage, Inc. facility, with lowlying outcrops extending south of the facility (Milepost 40.70 to 40.76).

In many other areas, the track is situated on a raised embankment that slopes from the edge of the existing track in the area of the proposed track addition. The highest embankments and steepest slopes are located where this project segment extends along the west side of Lake Quinsigamond. At the closest point to the lake (within 300 feet), the tracks are situated at an elevation of roughly 50 feet above the lake elevation and are situated at substantially higher elevations than properties along Lake Avenue, which extend along the lake shoreline and are situated at the base of a steep railroad embankment. Slopes along the railroad embankment in this area alongside the track are steeper than 1:1 in places.

The west side of the tracks (where the additional track would be added) is also located on a raised embankment in the following areas:

- South of Franklin Street (south of Plantation Street) to Hamilton Street,
- Areas located across from Coburn Avenue (on the opposite side of the tracks),
- Areas extending from Sunderland Road to Route 20, including areas east of Route 20.

5.6. Traffic

5.6.1. Description of Ashland-Framingham Segment

The only location where the proposed track improvements may involve an at-grade roadway crossing is at the Main Street grade crossing in Ashland. The tracks pass under Fountain Street, which is carried over the tracks on a recently constructed bridge structure.

Main Street is a two-lane urban arterial type roadway providing north-south traffic movements in downtown Ashland. The roadway in the vicinity of the grade crossing is primarily abutted by commercial properties. The Main Street intersections with Summer Street and with Front Street are signalized.

5.6.2. Description of Worcester-Millbury -Grafton Segment

This project segment includes a number of overhead or undergrade roadways. From northwest to southeast, these crossing include:

- Putnam Lane (undergrade bridge) (Milepost 43.31),
- Plantation Street(overhead bridge) (Milepost 42.78),
- Hamilton Street (overhead bridge) (Milepost 41.67),
- Sunderland Road (undergrade bridge) (Milepost 40.23), and
- Route 20 (undergrade bridge) (Milepost 39.93).

The majority of these bridges will not require major reconstruction that would affect traffic conditions, but reconstruction of Hamilton Street and Sunderland Road will require traffic maintenance during construction. Traffic conditions at the two bridges to be reconstructed are described below.

5.6.2.1. Hamilton Street (Milepost 41.67)

Hamilton Street is a two-lane collector type roadway providing east-west traffic movements between Lake Avenue, Plantation Street and Grafton Street (Route 122). Review of available traffic data indicates approximately 9,000 vehicles a day traveled this roadway just west of Coburn Avenue in 1997. The roadway in the vicinity of the bridge is approximately 40 feet wide with an 8-foot-wide sidewalk on the south side. The bridge carries Hamilton Street over the Framingham/Worcester Line. Hamilton Street is a Worcester Regional Transit Authority bus route. The roadway is abutted by residential houses in the vicinity of the bridge.

The existing bridge structure consists of precast butted box beams supported by granite masonry abutments. The superstructure was replaced in 1993.

5.6.2.2. Sunderland Road (Milepost 40.23)

Sunderland Road is a two-lane collector type roadway providing east-west traffic movements between Route 20, Grafton Street (Route 122), Lake Avenue, and Massasoit Road. Review of available traffic data indicates approximately 14,000 vehicles a day traveled this roadway just east of Grafton Street in 1989. The roadway in the vicinity of the bridge is approximately 40 feet wide with a 6-foot-wide sidewalk on the southerly side between the bridge and Lake Street. The Sunderland Road intersections with Grafton Street and with Lake Street are signalized. The roadway immediately adjacent to the bridge is abutted by residential houses.

The existing bridge is a reinforced concrete arch structure and carries the Framingham/Worcester Line over Sunderland Road. The vertical clearances over Sunderland Road are low: 10'-6" at the curb line and 12'-10" at the center of the road. The westerly fascia of the bridge has numerous marks from trucks hitting the low chord of the bridge. The bridge is located on a portion of the roadway which combines a horizontal curve with a downgrade slope traveling from west to east.

5.7. Utilities

The addition of a third track in selected areas between Worcester and Framingham involves construction activities within a linear corridor that contains active underground and overhead utility systems, including utilities that either cross the corridor or run along it. In many cases, utilities are located on bridges within the project corridor and, depending upon the scope of the bridge work required, may have to be relocated as part of the bridge work. For instance, the Hamilton Street Bridge carries two gas mains and a water main across the railroad tracks. Existing underground and overhead utilities crossing laterally through the railroad right-of-way (pipelines, conduits, overhead wires) are assumed to have been designed in accordance to railroad requirements (designed for railroad loadings, protective sleeves, encasement, overhead clearances, etc.) and would be minimally impacted.

Further research on the existing utility agreements with CSX will be required to determine whether the costs for utility relocations necessary to accommodate project construction would be paid for by the MBTA, CSX, or the utility.

Several major utilities are located longitudinally within the right-of-way and potentially could have more significant impacts on the project. These utilities include an overhead high-voltage transmission system located within the Worcester-Millbury -Grafton segment of the project and a fiber optic system along the entire project. There is a strong possibility that the fiber optic system also carries the CSX signal information. Each of these was evaluated further as part of this study as discussed below.

5.7.1. High-Voltage Transmission System (owned by National Grid)

A major overhead high-voltage transmission system is located within the railroad right-of-way starting at approximately MP 42.44 in Worcester and extending to approximately MP 38.95 in Grafton. This high-voltage transmission system, owned by National Grid, is located on a series of forty-five (45) steel poles along the south side of Track 2. Within the project area, 29 of these utility poles are located in the area of the proposed track improvements. At either end of the above limits, the overhead transmission system crosses over the tracks to poles along the north side of Track 1, well away from any proposed trackwork. The distance between poles varies but is typically around 400 feet.

At the Worcester end of the transmission system, the overhead wires cross from a pole on the south side of Track 2 to a pole on the north side of Track 1 from where the transmission system connects into the Bloomingdale Substation, at Milepost 42.45. The substation is located within about 100 feet of the railroad right-of-way on the north side of Frank Street and abuts the Eastview Apartment complex.

In Grafton (near MP 39.00), the high-voltage transmission system on the south side of the tracks crosses over the tracks to the north and at that location, ties into a cross-country type overhead transmission system which crosses the tracks at close to a 90 degree angle. Just west of the above area, at approximately MP 39.15 in Millbury, another cross-country type overhead utility transmission system crosses over the tracks. That system, including poles/supports, would not be impacted by the proposed track improvements, since they are well away from the tracks.

5.7.2. Fiber Optic Communication System (owned by Sprint)

5.7.2.1. Utilities along the Ashland-Framingham Segment

A fiber optic communication system is located within the existing railroad right-of way for the entire length of the proposed track improvements from Ashland to Framingham. This system is owned by Sprint. The fiber optic lines are contained within an underground conduit system (4-inch duct) generally located 6½ feet south of Track 1 (between Tracks 1 and 2). Records indicate that approximately 1,850 feet of the fiber optic system in the area of the Fountain Street Bridge and Sudbury River Bridge is located south of Track 2 (and not between Tracks 1 and 2). There are handholes located at varying intervals along the fiber optic system. These handholes, which provide access to the fiber optic cable (for pulling cables through the conduit, splicing, etc.) are located either between Tracks 1 and 2 or immediately adjacent to the outermost edge adjacent to Track 2.

5.7.2.2. Utilities along the Worcester-Millbury-Grafton Segment

A fiber optic communication system is located within the existing railroad right-of way for the entire length of the proposed track improvements from Worcester to Grafton. This system is owned by Sprint. The fiber optic lines are contained within an underground conduit system (4-inch duct) generally located 6½ feet south of Track 1 (between Tracks 1 and 2). There are handholes located at varying intervals along the fiber optic system. These handholes, which provide access to the fiber optic cable (for pulling cables through the conduit, splicing, etc.) are located either between Tracks 1 and 2 or immediately adjacent to the outermost rail of Track 1 or 2.

At the Worcester end of the project, the fiber optic system is located south of Track 2 from the westerly project limit to a point approximately 1,250 feet east of the railroad bridge over Putnam Street. At that point the fiber optic system crosses below Track 2 and then, from that point easterly, is located between Tracks 1 and 2 as described above.

5.8. Land Use and Zoning

5.8.1. Land Uses along the Ashland-Framingham Segment

Land uses along the Ashland-Framingham portion of the project consist predominantly of commercial businesses or industrial uses, with some mixed residential uses. In most areas, the tracks are buffered from adjoining uses by vegetation or slopes within or adjoining the right-of-way.

At the western end of this segment, at the Main Street grade crossing, the tracks cross through the central business district in downtown Ashland (refer to Figure 13B). At the grade crossing, the tracks adjoin the

Ashland World War Memorial in the municipal square and parking lots for local businesses, on the east side of Main Street. The west side of Main Street north of the grade crossing adjoins a BankNorth ATM and Lunker's Bait and Tackle Shop, and uses towards the back of the property include Mehitable's Bakery. Behind this commercial property, to the west, the tracks adjoin the back of the parking lot for the Ashland Central Fire Station and the Ashland Police Station, which front on Main Street. The southwest side of the Main Street grade crossing is occupied by Stone's Public House, a restaurant, with the Ashland Professional Center located along the tracks behind this property to the west.

The remainder of the line through Ashland and Framingham adjoins primarily commercial or industrial land uses with some residential housing, and adjoins parking for commercial industrial properties in a number of locations, including areas along Front Street and Homer Avenue. The right-of-way borders on the former railroad station, which currently houses a professional office building. Further to the east, the north side of the right-of-way borders on a parcel on Front Street recently acquired by the Ashland Redevelopment Authority for redevelopment, and the south side of the right-of-way adjoins a parking area for the Ashland Technology Center, and. The tracks border on mixed commercial and residential areas where the rail line adjoins and parallels Route 135. East of where the tracks cross Framingham Reservoir No. 2, the tracks extend between the reservoir and Route 135, adjoining lands that include undeveloped forestlands.

5.8.2. Land Uses along the Worcester-Millbury -Grafton Segment

The Worcester segment extends alongside land uses that include industrial uses, residential properties, and also adjoins several community facilities or parks. These different types of land uses along the project are described below and are shown on Figures 5 and 7 and Figures 14A through 14T.

5.8.2.1. Industrial/Commercial Areas

Industrial/commercial areas are located along four major segments along the project area, as described below.

- **Industrial areas located near and east of Worcester Yard** include the CSX rail yard itself and industrial, commercial, and automotive uses along Franklin Street and Shrewsbury Street.
- **Commercial areas off Plantation Street** include service-oriented industries, such as medical and financial services located at the top of the slope where the railroad is located in a steep cut section. Offices for Legg Mason, U Haul, and Worcester Day Habilitation Services and associated parking lots are located north of the tracks and south of adjoining Route 9 (Belmont Street). Smaller office uses, including offices for MBA Practice Management, Inc., Clinical One Placement Pros, and Sister's of Notre Dame De Namur, are located east of Plantation Street and adjoin the south side of the railroad cut.
- **Industrial properties along Wells, Solferino, and Northboro Streets, situated off Plantation Street,** and associated parking adjoin the proposed area of the track addition, southeast of the Plantation Street crossing. The majority of property fronting on the tracks in this area consists of a large parking lot and warehousing facilities. Industrial properties along Wells Street include PADCO Inc. (Architectural Woodworking), Mike's Service Center, and GMS Automotive. Adjoining industrial properties in this area include the Stagparkway Service Center, Alside Supply Center, and Bloch New England, Inc. off Northboro Street.
- To the south, and just south of the midpoint of the project area, **Sack Storage, Inc.** has a siding adjoining the area of the track improvements.
- **Industrial and commercial areas surround and extend east of the Route 20 bridge**, where the tracks extend adjacent to industrial uses in the southeast corner of Worcester, Millbury, and Grafton. The Southwest Commons Mall is located east of the tracks, south of Sunderland Road and north of Route 20. Approaching Route 20, the tracks are adjoined on the east side by the Camosse Masonry Supply Company, which has a siding north of Route 20. The east side of Route 20 (known locally as the Southwest Cutoff) at the railroad crossing adjoins a number of industrial and commercial properties including Banknorth, facilities for Camosse Masonry, A. Duquette & Sons, Inc., and, south of the tracks, Colonial Auto Body Works and Auto Sales. Other industries to the east of Route 20, south of the tracks, include Stanlock Fasteners, located on the east side of the pond.
- The **Wyman Gordon Industrial Area** in Grafton adjoins the south side of the tracks at CP39 and the eastern end of this project segment. This industrial area south of the tracks houses industries that include Cooper Cameron Valves, Fiba Technologies, Inc., and the Wyman Gordon Company. Areas to the north of the tracks include industrialized areas and automotive uses along Creeper Hill Road.

5.8.2.2. Residential Areas

Residential housing in the vicinity of the project includes single-family homes and residential apartments. Residential areas that adjoin the tracks include housing:

- along Tampa Street (Milepost 42.96),
- at the Plantation Street Bridge (Milepost 42.78),
- new construction east of Marlboro/Franklin Street off Papagni Circle (Milepost 42.30 to 42.33),
- at the Hamilton Street Bridge and Elton Street (Milepost 41.60 to 41.67),
- along Orton Street Extension (Milepost 41.33), and
- at and approaching the Sunderland Road Bridge, including properties off Vig's Way and Billow Street (Milepost 40.23 to 40.36).

The majority of these adjoining residences are situated above the grade of the tracks at the top of ledge cuts or steep slopes, with the exception of properties in the area of the Sunderland Road underpass.

5.8.2.3. Community Facilities and Parks/Recreation Areas

There are several community facilities or parks along the project. These properties include:

- The **Ecotarium** and **North High School** in Worcester, which are both located off Harrington Way and adjoin each other along the west side of the tracks. The Ecotarium, located to the north of the high school, is a private, non-profit organization. The Ecotarium property includes nature trails and museum exhibits and is open to the public for a fee. North High School is a public school, with roughly 1,200 students in grades 9 through 12. The ballfields on the property are available for use upon permission by the school and are used for Little League games.
- South of these properties, **Lake Park**, a 75-acre municipal park, adjoins the east side of the tracks. The park trail along Coburn Avenue extends parallel to and adjacent to the tracks.
- To the south of this property, on the opposite (west) side of the tracks is the **Perkins Farm Conservation Area** that is jointly managed by the Worcester Conservation Commission and the Massachusetts Audubon Society. This is the site of the last working farm in Worcester. This is a roughly 75-acre conservation area that includes hiking trails, with access available off of Route 122, behind the Perkins Farm industrial area and shopping center.

5.8.3. Zoning

The zoning classifications in the study area that were obtained from MassGIS are shown in Figure 4. Zoning classifications roughly correlate to land uses, as described above. The zoning along each project segment is described below.

5.8.3.1. Zoning along the Ashland-Framingham Segment

The zoning classifications along this project segment are shown in Figure 4 and zoning are described by area below.

- **Industrial:** Areas west of Cherry Street are zoned for industrial use. Industrial zoning also applies to areas situated south of the tracks, east of Homer Avenue and west of Fountain Street, which include the Ashland Technology Centre.
- **Downtown Commerce:** Downtown commerce zoning applies in the Ashland business district that surrounds the Main Street grade crossing and extends east along Front Street and Homer Avenue. North of the tracks, this zoning extends east to Fountain Street.
- **Residential:** Residential zoning applies to a small area east of Cherry Street in Ashland. The area east of where the tracks cross Framingham Reservoir No. 2 are zoned as residential, predominantly in the area north of the tracks and south of the reservoir. A small area south of the tracks, north of Route 135 (Waverly Street) is also zoned for residential use.
- **Highway Commerce:** The area south of the tracks, east of Fountain Street that extends along Route 135 (Waverly Street) is zoned for highway commerce uses.
- **General Residential:** In Framingham, the zoning along the tracks and Route 135 changes to general residential.

5.8.3.2. Zoning along the Worcester-Millbury-Grafton Segment

The zoning along the Worcester-Millbury -Grafton segment of the project area consists predominantly of industrial/commercial or residential zoning, as shown in Figure 5 and as described below.

- **Industrial/Commercial:** The industrial/commercial zone in Worcester, surrounding and east of Worcester Yard, Franklin Street, and Shrewsbury Street on the western end of the project are zoned for general industrial (or general manufacturing) uses. The areas east of Plantation Street are zoned for light industrial (or limited manufacturing) use, and general industrial (manufacturing) zoning extends south of the tracks continuing east to Northboro Street. Near the midpoint of the project area, the areas west of the tracks surrounding the Sack Storage, Inc. facility are zoned for general industrial (limited manufacturing) use.

  Areas in the vicinity of Sunderland Road are zoned for general industrial (or limited manufacturing) uses, and this zoning designation continues through Millbury on the north side of the tracks. There is also an area, on the south side of the tracks and east of Route 20, that is zoned for general industrial (general manufacturing). In Millbury, the south side of the tracks adjoins an industrially zoned area near the Grafton town line. In Grafton, the areas on the north side of the tracks are zoned for office/light industry, and areas on the south side of the tracks (including the Wyman-Gordon Industrial Area) are zoned for industrial use.
- **Residential:** The south side of the tracks, east of Worcester Yard, includes residential and multi-family low-density (or limited residential) zoning, which extends east to Plantation Street. South of industrially zoned areas at Northboro and Plantation Streets, zoning for limited residential (including low-density multi-family) use extends, on the west side of the tracks, south to the area around the Orton Street Extension. On the east side of the tracks, this residential zoning designation extends further south to the area around Sunderland Road. The areas surrounding the Orton Street Extension and the Perkins Farm Conservation Area are zoned for single-family residential use. South of the Sack Storage, Inc. facility, zoning in areas surrounding Sunderland Road are for limited residential (including low-density multi-family) use. Residential zoning applies to the majority of areas south of the tracks in Millbury, in addition to a small area north of the tracks at the Millbury town line

5.9. Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*, and the U.S. Department of Transportation Order on Environmental Justice

(DOT Order 5610.2) set forth policies to ensure that federal actions do not disproportionately affect minority or low-income populations in the U.S. The Massachusetts Executive Office of Environmental Affairs has enacted an environmental justice policy that reinforces and enhances efforts to meet the existing legal mandates in Title VI of the federal Civil Rights Act of 1964. Title VI of the Civil Rights Act of 1964 and related statutes assure that individuals are not excluded from participation in, denied the benefit of, or subjected to discrimination under any program or activity receiving federal financial assistance on the basis of race, color, national origin, age, sex, or disability.

The U.S. DOT Order 5610.2 states that in order to achieve environmental justice as part of its mission it must "identify and address, as appropriate, disproportionately high and adverse human health or environmental effects, including interrelated social and economic effects, of its programs, policies, and activities on minority populations and low-income populations in the United States." Figures 4 and 5 show environmental justice populations, based on MassGIS mapping that displays neighborhoods across the state with high minority, non-English speaking and low-income populations, based on 2000 U.S. Census data. There are no environmental justice populations identified along the Ashland-Framingham project segment. Both sides of the roughly ½-mile section of the track extending east to CP43 extend through areas mapped as having environmental justice populations, and an additional ½-mile section of track east of CP43 borders environmental justice populations located predominantly north of the tracks.

5.10. Noise and Vibration

5.10.1. Methodology

Although the existing Framingham/Worcester Line currently accommodates frequent commuter rail and freight service, a preliminary screening level analysis of the approximate number and severity of potential noise and vibration impacts from rail operations was performed. A site survey to identify noise-sensitive receptors and land uses was performed.

Noise impact criteria used for this study are based on existing noise levels at nearby receiver locations. It was assumed for the purposes of this assessment that existing noise levels at nearby receiver locations are dominated by existing rail activity, and the existing noise levels were predicted based upon projected existing rail activity. This is a fair assumption for homes that are within a few hundred feet of a busy rail line and relatively far removed from other constant noise sources (such as busy streets or industrial facilities). This situation does exist for many of the homes analyzed in this study.

Since trains (particularly for freight) along the Framingham/Worcester Line operate 24 hours a day, the noise metric used for this study is the A-weighted decibel (abbreviated dBA), which takes into account the frequency response of human hearing. For residential land uses, the 24-hour Day-Night Noise Level metric (abbreviated Ldn) is used for impact assessment. This metric represents the 24-hour equivalent noise level with a 10 decibel penalty for noise during nighttime hours (10 PM to 7 AM). The table below presents typical noise levels for ordinary activities as a reference.

Although the length of track between the Framingham and Worcester stations over which new proposed service will increase, potentially resulting in noise increases, is approximately 22 miles in length, this analysis only considered receiver locations within the 6.5-mile area where track improvements are proposed in two separate sections. Although the addition of a third mainline track will bring rail traffic physically closer to some nearby homes, the primary mechanism that will cause noise levels to increase at these homes is the increase in total rail traffic.

Table 1—Common Analogies for dBA Sound Pressure Levels

Common Sound Environment	Sound Pressure Level (dBA)
Threshold of pain	120
Airport runway	110
Typical nightclub	100
OSHA limit for 8-hour exposure	90
Construction area	80
Area near a major highway	70
Urban area during day	60
Quiet suburban area during day	50
Quiet suburban area at night	40
Quiet rural area at night	30
Inside broadcast studio	20
Inside audiometric booth	10
Threshold of hearing	0

5.10.2. Existing Receptors

A site visit identified 115 residential properties and seven commercial properties within approximately 200 feet from the center of the existing rail corridor where a third mainline track is proposed to be added. Of these properties, 48 residential receptors and two commercial receptors are situated in Ashland, and 74 residential properties and five commercial properties are located in Worcester. Most of the identified structures were single-family homes, along with several multiple-family structures.

5.10.3. Existing Noise Levels

Existing noise levels were predicted for identified residential receiver locations within approximately 200 feet from the center of the existing Worcester corridor where a third mainline track is proposed to be added. The predictions are consistent with methods established in the FTA Transit Noise and Vibration Impact Assessment manual. Table 2 below includes the operational assumptions used in the predictions, and Table 3 presents the FTA land use categories used in performing noise assessment.

Table 2—Noise Prediction Assumptions, Existing Rail Service on Framingham/Worcester Commuter Rail Line

Noise Source	Assumed Average Source Characteristics
Freight Rail	13 trains/day, 9 trains/night, 2 locomotives + 34 cars/train, 50 mph
Amtrak Rail	2 trains/day, 0 trains/night, 1 locomotive + 6 cars/train, 60 mph
MBTA Rail	17 trains/day, 4 trains/night, 1 locomotive + 7 cars/train, 60 mph

Predicted noise levels for the identified residential and commercial receivers ranged between 61 and 72 dBA, Ldn. These land uses are classified as Category 2 under the FTA Noise Impact Criteria. These predicted noise levels assumed noise generated by rail operations, but did not include train horn soundings.

Table 3—Land Use Categories and Metrics for Transit Noise Impact Criteria

Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor Leq(h)	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use.
2	Outdoor Ldn	Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor Leq(h)	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, and churches where it is important to avoid interference with such activities as speech, meditation and concentration on reading material. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios, and concert halls fall into this category. Places for meditation or study associated with cemeteries, monuments, museums. Certain historical sites, parks and recreational facilities are also included.

Leq(h) is the noisiest hour of transit-related activity during hours of noise sensitivity.

5.11. Water Resources

The project is located within the watersheds of the Sudbury River and Blackstone River Basins. There are no Outstanding Resource Waters in the project area, and review of the MassGIS public water supply data (2000) did not reveal any public water supplies within the project area.

Water resources include surface waters, smaller drainages, and groundwater aquifers. These different types of water resources are described in more detail below, by project segment.

5.11.1. Water Resources along the Ashland-Framingham Segment

5.11.1.1. Sudbury River and Framingham Reservoir No. 2

The Ashland-Framingham segment of the project is located within the Sudbury River watershed. The western end of this project segment extends roughly parallel to (and south of) the Sudbury River. At Milepost 23.83, the tracks cross over the Sudbury River, upstream of where the river discharges to the east into Framingham Reservoir No. 2 (Brackett Reservoir). The project crosses over Framingham Reservoir No. 2 at a stone and concrete arch bridge at Milepost 23.54 (also known as Sudbury River Bridge 23.54).

Northeast of this project segment, the Sudbury River continues as a downstream tributary to the Framingham Reservoir system. Downstream of (and northeast of) this project segment, Framingham Reservoir No. 2 flows into Framingham Reservoir No. 1 (Stearnes Reservoir), which, in turn, supplies the downstream section of the Sudbury River.

The Framingham Reservoir No. 2 is owned and managed by the Massachusetts Department of Recreation and Conservation (Division of Water Supply). Framingham Reservoir Nos. 1 and 2 are situated downstream of emergency water supplies within the Massachusetts Water Supply Authority system (Sudbury Reservoir and Framingham Reservoir No. 1—Foss Reservoir). However, Brackett Reservoir (Framingham Reservoir No. 2) is classified as Class B and is not used as a drinking water supply source. Review of the MassGIS public water supply data did not reveal any water supplies within the project area. Brackett and Stearns Reservoirs are not considered emergency water supplies. The sediments within Framingham Reservoir Nos. 1 and 2 have been contaminated with mercury from the Nyanza Superfund site. The U.S. Environmental Protection Agency has indicated that the contamination is contained in the sediment and does not affect the water quality of the reservoirs.

Roughly 6 miles downstream of this project segment, the section of the Sudbury River extending south to join the Concord and Assabet Rivers is part of the designation of the Sudbury, Assabet, and Concord Rivers as a National Wild and Scenic River.

5.11.1.2. Culverts and Drainages

The larger waterbodies in the project area are fed by smaller drainages that cross the track in culverts. The smaller drainages at these culverts are described below, from west to east:

- **Milepost 24.39**—Culvert carries drainage west of the Main Street grade crossing;
- **Milepost 24.08**—Culvert carries drainage across the tracks where the tracks extend close to both Front Street, on the north, and Homer Avenue, on the south.
- **Milepost 23.36**—Culvert east of the Framingham Reservoir No. 2 crossing carries drainage north across tracks to discharge into the reservoir;
- **Milepost 23.23**—Culvert carries drainage north across tracks to discharge into Framingham Reservoir No. 2;
- **Milepost 23.10**—Culvert carries drainage north across tracks to discharge into Framingham Reservoir No. 2;
- **Milepost 22.94**—Culvert carries drainage north across tracks to discharge into Framingham Reservoir No. 2.

5.11.1.3. Aquifers

Groundwater aquifers in the study area are shown in Figures 10 and 11, as identified by the MassGIS Aquifers datalayer (1997). The only aquifer that crosses the project is a medium-yield aquifer in the downtown Ashland area in the vicinity of the Main Street grade crossing. Medium-yield aquifers also border on the project where it crosses the Sudbury River and Framingham Reservoir No. 2 and where the tracks extend alongside the reservoir.

5.11.2. Water Resources along the Worcester-Millbury-Grafton Segment

5.11.2.1. Lake Quinsigamond and Other Waterbodies

The Worcester-Millbury-Grafton segment of the project extends through the Blackstone River Basin. This project segment extends south along the west side of Lake Quinsigamond, passing within 300 feet of the lake at its closest point (where the tracks are separated by properties along Lake Avenue). There are also two small ponds and one large pond (east of the Route 20 bridge) that are located adjacent to or in close proximity to the track, but there are no major waterway crossings along this project segment. Pond 1 is located west of the tracks on the Ecotarium property (Figure 14H). A small pond (Pond 2) is located on the east side of the tracks at Milepost 40.46, across from the Sack Storage Facility, Inc. and siding (Figure 14P). Pond 3 is located east of Route 20 (Milepost 39.74) alongside the southwest side of the tracks (Figures 14S and 14T).

5.11.2.2. Culverts and Drainages

The culverts carrying drainages under the tracks are described below, from north to south:

- **Milepost 42.61**—Culvert that connects drainage from the industrial property off of Wells Street to areas across the tracks off Frank Street;
- **Milepost 42.56**—Culvert that connects drainage from the industrial property off of Wells and Solferino Streets to areas across the tracks off Frank Street;
- **Milepost 42.15**—Culvert that connects drainage from the lowlying areas near a pond (Pond 1) on the Ecotarium property to areas east across the tracks;
- **Milepost 41.89**—Culvert north of Hamilton Street on the North High School property that connects drainage from a stream across the tracks to areas that discharge into Lake Quinsigamond;
- **Milepost 41.57**—Culvert that connects drainage from the west side of the tracks to Lake Park, on the east;
- **Milepost 41.45**—Culvert that connects drainage from the west side of the tracks to Lake Park, on the east;
- **Milepost 41.08**— Culvert north of Sunderland Road, that carries drainage from the Perkins Farm Conservation Area across the tracks (west of Lake Avenue) and discharges towards Lake Quinsigamond;
- **Milepost 40.96**—Culvert north of Sunderland Road, that carries drainage from Perkins Farm Conservation Area across the tracks (west of Lake Avenue) and discharges towards Lake Quinsigamond;
- **Milepost 40.51--**Culvert that discharges from the Sacks Storage Facility across the tracks to the vicinity of Pond 2.
- **Milepost 40.14**—Culvert, south of Sunderland Road, carrying drainage that connects to areas at the Southwest Commons Mall across the tracks;
- **Milepost 39.91 –**Culvert near the Route 20 Bridge.
- **Milepost 39.77**—Culvert that connects drainage from northwest corner of pond east of Route 20 (Pond 2) to areas across the tracks in Millbury;
- **Milepost 38.88 –**Culvert that is located north of the Wyman-Gordon Industrial Area.
- **Milepost 38.80**—Culvert that connects drainage from a stream on the Wyman-Gordon Industrial Area in Grafton to areas to the north across the tracks.

5.11.2.3. Aquifers

Groundwater aquifers in the study area are shown in Figures 10 and 11. The only aquifer along the project is a medium-yield aquifer in the vicinity of the Route 20 crossing.

5.12. Floodplains

The Federal Emergency Management Agency (FEMA) has prime responsibility for delineating floodplains for the purposes of floodplain regulation and flood insurance. The 100-year flood is the flood elevation that has a 1% chance of being equaled or exceeded each year. The 500-year flood is the flood elevation that has a 0.2% likelihood of being equaled or exceeded each year. The floodplain mapping prepared by FEMA for the City of Worcester and the Towns of Millbury, Grafton, Ashland, and Framingham were reviewed to identify floodprone areas in the study area.

5.12.1. Floodplains along the Ashland-Framingham Segment

Within the study area, the areas mapped as 100-year floodplain and 500-year floodplain extends along the Sudbury River and Framingham Reservoir No. 2 where these waterbodies cross the tracks. The FEMA mapping shows that, at the Sudbury River bridge crossing, areas of the 500-year floodplain along the river extend over the tracks over a distance of roughly 1,800 feet from the area where the tracks are closely bordered by Front Street and Homer Avenue and extending to east of the Fountain Street bridge. Areas within the 100-year floodplain cover a narrower portion of the tracks in this area, and are mapped at elevation 187 feet (NGVD 1929) north of Front Street and elevation 182 feet south of the tracks, close to Homer Avenue. The 100-year flood also occupies lowlying areas between the tracks and Front Street, on the north, and borders on the south side of the tracks between Homer Avenue and Fountain Street.

At the Framingham Reservoir No. 2, the 100-year floodplain areas closely follow the edge of the reservoir, upstream of the rail crossing and are situated at elevation 175 feet. Downstream of the rail bridge crossing of the reservoir, the 100-year floodplain is broader (at elevation 180 feet), and extends along the south side of the tracks, extending west to Fountain Street.

5.12.2. Floodplains along the Worcester-Millbury-Grafton Segment

There are no areas within either the 100-year or 500-year floodplains along this project segment.

5.13. Wetlands

Wetlands generally include swamps, marshes, bogs, and similar areas [33 CFR 328.3(b)] and can be isolated or bordering on a waterbody/waterway. Wetlands are subject to protection under Section 404 of the U.S. Clean Water Act and the Massachusetts Wetlands Protection Act.

The U.S. Army Corps of Engineers, which has jurisdiction under the Federal Clean Water Act (under 33 CFR Parts 321-330, November 12, 1986), defines waters of the United States as aquatic habitats that include open water areas and wetlands. Wetlands are further defined as those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

Within and adjacent to the project area, there are five types of resource areas subject to protection under the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00). Wetlands were identified through review of MassGIS wetlands data (as shown on Figures 8 and 9) and through field reconnaissance. These applicable wetland resource areas are defined below.

- **Bank** normally abuts and confines a water body. Bank occurs between a water body and a vegetated wetland or adjacent floodplain or between a water body and upland.
- **Bordering Vegetated Wetland** include those vegetated freshwater wetlands that border on water bodies and waterways.
- **Land under Water Bodies/Waterways:** The land area under any creek, river, stream, pond or lake is a resource area subject to protection.
- **Bordering Land Subject to Flooding:** The boundary of Bordering Land Subject to Flooding (BLSF) is defined as the maximum lateral extent of floodwater, which will theoretically result from the statistical 100-year frequency storm, as defined by the FEMA Flood Insurance Rate Maps (and discussed in Section 5.12.
- **Isolated Land Subject to Flooding:** Isolated Land Subject to Flooding (ILSF) is defined as an isolated depression or closed basin without an inlet or outlet. It is an area which at least once per year confines standing water to a volume of at least 1/4 acre-feet and to an average depth of at least six (6) inches.
- **Riverfront Area:** Land between a perennial river's mean annual high-water line and a parallel line located 200 feet away, measured horizontally outward from the river's mean annual high-water line.

Wetland occurrences along the project area are discussed by project segment below.

5.13.1. Wetlands along the Ashland-Framingham Segment

Along this project segment, resources along Framingham Reservoir No. 2 include bank, 100-year buffer zone, and 200-foot riverfront protection areas. A portion of the area of the proposed track improvements borders on the banks of the reservoir along a roughly 500-foot section. Lands subject to flooding are described under the Section 5.12, *Floodplains*.

The Sudbury River includes areas of 100-year buffer zone and 200-foot riverfront protection areas in the area of the proposed track improvements, as well as land subject to flooding.

5.13.2. Wetlands along the Worcester-Millbury-Grafton Segment

Wetland resource areas along this project segment include bordering vegetated wetlands, bank, and isolated vegetated wetland (IVW). A 100-foot buffer zone extends from regulated bank and bordering vegetated wetlands. The ten wetland areas identified alongside the area of the proposed track improvements, on the south side of the tracks, are described below.

- **Wetland A** is located north of the stone box culvert at Station 42.15 that carries drainage from the area near a pond on the Ecotarium property east across the tracks. This wetland drains to the stone box culvert and is dominated by Japanese knotweed (*Polygonum cuspidatum*). Wetland A is not identified as a wetland on the U.S. Geological Survey (USGS) topographic maps or the MassGIS data.
- **Wetland B** extends from an intermittent stream that appears to originate in the vicinity of the pond (Pond 1) on the Ecotarium property. This wetland is a forested wetland that is dominated by red maple (*Acer rubrum*) and qualifies as bordering vegetated wetland. This intermittent stream is shown as originating from Pond 1 on the USGS topographic map of the project area (Worcester North, MA Quad, 1983) and has an associated bank resource area. Wetland B is identified by MassGIS as a wooded swamp, deciduous wetland (WS1).
- **Wetland C** is located south of the Hamilton Street Bridge between power poles 35 and 36 (Milepost 41.45), across the tracks from Coburn Avenue. This bordering vegetated wetland is a combination or emergent and shrub/scrub wetland. The emergent portion of the wetland is closer to the tracks and is dominated by cattail (*Typha latifolia*) and common reed (*Phragmites australis*). Wetland C is identified by MassGIS as a shrub swamp (SS).
- **Wetland D** is an isolated vegetated wetland located in the vicinity of the pond (Pond 3) just south of Route 20. This wetland is a forested wetland dominated by red maple. Wetland D is not identified on USGS topographic maps or MassGIS.
- **Wetland E** is a forested/emergent wetland bordering Pond 3, south of Route 20. This bordering vegetated wetland is dominated by red maple in forested areas and common reed in emergent areas. The USGS topographic map for the project area (Milford, MA Quad, 1982) shows a small pond and associated wetland just northwest of the Worcester/Millbury line. MassGIS identifies Pond 2 and its associated wetland system as a deep marsh (DM).
- **Wetland F** is a small isolated vegetated wetland located just northwest of the Worcester/Millbury line. This forested wetland is dominated by red maple. Wetland F is not identified on USGS topographic maps or MassGIS.
- **Wetlands G, I, J and K** are small isolated vegetated wetlands in low areas along the south side of the track in Millbury. These small forested wetland areas are dominated by red maple. These isolated wetlands are not identified on USGS topographic maps or MassGIS.
- **Wetland H** is located between Wetlands G and I and appears to have an intermittent stream flowing through it and therefore qualifies as bordering vegetated wetland. This forested wetland is also dominated by red maple. The USGS topographic map for the project area (Milford, MA Quad, 1982) indicates that an intermittent stream originates in this wetland and flows southeast. This intermittent stream has an associated bank resource area. Wetland H is identified by MassGIS as a wooded swamp, deciduous wetland (WS1).
- **Wetland L** is an emergent/scrub-shrub wetland located under the power lines just east of the Millbury/Grafton town line. This wetland is dominated by common reed. This wetland is not identified on the USGS topographic map for the project area (Milford, MA Quad, 1982); however, MassGIS identifies Wetland L as a shallow marsh, meadow or fen (M).
- **Wetlands M and N** are located just north of the Wyman Gordon property. These shrub/scrub wetlands border an intermittent stream that originates in Flint Pond on the north side of the tracks and therefore qualify as bordering vegetated wetland. These wetlands are not identified on USGS topographic maps or MassGIS; however, the stream channel is clearly visible on the MassGIS aerial photograph. In addition to the bordering vegetated wetland, the stream has an associated bank resource area.

5.14. Threatened or Endangered Species/Protected Habitats

The presence of endangered or threatened plant or animal species was identified through coordination with the U.S. Fish and Wildlife Service and the Massachusetts Natural Heritage and Endangered Species Program (MNHESP). The MassGIS data were also reviewed, including the 2005 MNHESP Estimated Habitats of Rare Wildlife, the 2005 Priority Habitats for State-Protected Rare Species, and the 2003 Certified Vernal Pools.

According to the Areas of Critical Environmental Concern Program Guide, there are no identified Areas of Critical Environmental Concern within 500 feet of the study area in either Worcester or Framingham.

In correspondence dated December 7, 2005 and June 18, 2004, the U.S. Fish and Wildlife Service indicated that no federally listed or proposed threatened or endangered species or critical habitat under the jurisdiction of the U.S. Fish and Wildlife Service are known to occur in the project area.

Correspondence received from the MNHESP on January 5, 2005 and in June and July of 2004 and review of the MassGIS MNHESP data layers indicate that there are two areas of state-protected species or certified vernal pools in the project area. These are discussed by project segment below.

5.14.1. Protected Habitats along the Ashland-Framingham Segment

The only state-protected habitat in the project vicinity is a Priority Habitat Area for Rare Species along the Sudbury River in Ashland. The Massachusetts Natural Heritage and Endangered Species Program

reported that this corresponds to Priority Habitat 815 and Estimated Habitat 7330, which provides habitat for the Triangle Floater (*Alasmidonta undulata*), a mussel species of special concern.

5.14.2. Protected Habitats along the Worcester-Millbury-Grafton Segment

A Priority Habitat 828 designated by MNHESP corresponds closely to the location of the Perkins Farm Conservation Area. Correspondence received from MNHESP on July 21, 2004 indicated that the orange sallow moth (*Rhodoecia aurantiago*), a state-threatened species, occurs in the vicinity of the site. According to the MassGIS, this protected area also includes a Certified Vernal Pool designated by MNHESP.

5.15. Cultural Resources

Protection of cultural resources is mandated under Section 4(f) of the U.S. Department of Transportation Act, Section 106 of the National Historic Preservation Act, and Massachusetts laws (MGL Ch. 9, s. 26-27C) and regulations (950 CMR 71.00). Historically significant places and archeological resources are listed on the National Register of Historic Places and the State Register of Historic Places. Figures 6 and 7 shows those sites from the MassGIS that are listed on the State Register of Historic Places as historic districts or historic sites. Sites listed on the National Register of Historic Places would be included in the State Historic Register.

For the Worcester Commuter Rail Extension Study, an architectural survey of nearby buildings and an intensive archaeological survey were performed for a corridor that extended from Worcester Yard into Framingham Station. The architectural survey included a minimum distance of 50 feet from the centerline of the Framingham/Worcester Line. This survey area included both project segments in Ashland-Framingham and Worcester-Millbury-Grafton. The survey forms and archaeological investigations were submitted to the Massachusetts Historical Commission. As part of this survey, survey forms on the railroad bridges along the tracks were prepared. Consultation with Massachusetts Historical Commission (MHC) regarding the current study is underway.

5.15.1. Ashland-Framingham Segment

There are no sites listed in the National or State Register of Historic Places along the project segment in Ashland and Framingham. According to the MACRIS (MHC) database, the bridges on file include the Sudbury River Bridge (Boston and Albany Railroad Bridge #23.83) which was widened in 1911, and the Framingham Reservoir No. 2 Bridge (Boston and Albany Railroad Bridge #23.54), which was lengthened in 1913.

5.15.2. Worcester-Millbury-Grafton Segment

There are no National Register or State Register sites within 300 feet of the track. The closest listed site is the Bloomingdale Grammer School, situated approximately 400 feet south of the tracks along Plantation Street. However, the *Worcester Commuter Rail Extension Study Final Environmental Impact Report for the Railroad Right-of-Way and Layover Facility* references the East Worcester Street Public Works Area, located north of Worcester Yard as having been determined to be eligible for the National Register of Historic Places. This historic area consists of 15 late nineteenth- and early twentieth-century brick industrial buildings and some wood-frame residences industrial buildings on East Worcester Street.

The MHC MACRIS database indicates that survey forms exist for the following bridges along the Worcester-Millbury-Grafton segment:

- Putnam Lane (Boston and Albany Railroad Bridge #43.31) (1911),
- Plantation Street (Boston and Albany Railroad Bridge #42.78) (1934),
- Hamilton Street Bridge (common name= B and A Railroad Main Line Bridge) (1931),
- Sunderland Road Bridge (Boston and Albany Bridge #40.23) (1929), and
- Route 20 Bridge (Boston and Albany Railroad Bridge #39.92) (1931).

More recent modifications have been performed to the Hamilton Street Bridge (the superstructure was replaced in 1993) and the Plantation Street Bridge (concrete deck replaced in 1998).

The *Archaeological Reconnaissance Survey for the Worcester Commuter Rail Extension* recommended moderate or intensive archaeological surveys for those areas that would be disturbed by the construction of the second rail and that were deemed to have increased archaeological potential. The *Worcester Commuter Rail Extension Study Final Environmental Impact Report* indicated that archaeological testing that was performed in Worcester, Millbury, and Grafton indicated that construction of the Boston & Worcester Rail Line (now known as the Boston & Albany Line) in the 1830s impacted the entire rail corridor within the confines of MP 40 and MP33. This testing revealed that construction of the railroad and associated structures created extensive disturbance in the railroad corridor. Because no prehistoric materials were found, the historic materials recovered from the modern period, and every subsegment was found to be disturbed, no additional testing was recommended.

A Project Notification Form pursuant to M.G.L., Chapter 9, Section 26-27c, as amended by Chapter 254 of the Acts of 1988 (950 CMR 71.00) has been submitted to the Massachusetts Historical Commission regarding the proposed track improvements.

5.16. Oil and Hazardous Materials

5.16.1. Database Review

The summary tables presented below present the results of a review of federal and state regulatory agency databases using DataMap Technology Corporation's Environmental FirstSearch on-line database service. It should be noted that the numbers provided in the table do not include non-geocoded (unmapped) sites that might affect construction activities.

The following federal and state databases were searched:

- National Priority List (NPL);
- Comprehensive Response, Compensation, and Liability Information System (CERCLIS);
- No Further Remedial Action Planned (NFRAP);
- Resource Conservation and Recovery Act Treatment, Storage and Disposal Sites for Hazardous Materials (RCRA TSD);
- RCRA Corrective Action Sites (RCRA COR);
- RCRA Generators (RCRA GEN);
- Emergency Response Notification System (ERNS);
- State Sites and Spills; Solid Waste Landfills (SWL); and
- Registered USTs and Aboveground Storage Tanks (ASTs).

The results of the database review for the Ashland-Framingham project segment are shown in Table 4, and the results for Worcester-Millbury-Grafton are shown in Table 5. The information available from MassGIS on sites listed by the Massachusetts Department of Environmental Protection (MA DEP) are shown on Figures 10 and 11.

In general, regulatory issues relative to the release of Oil or Hazardous Materials (OHM) in the proposed construction corridors can be expected to be associated with a typical assemblage of urban and ex-urban commercial and light industrial establishments. These include, but are not necessarily limited to, gasoline stations, auto body shops, dry cleaners, and other facilities with underground storage tanks or hazardous materials handling operations. In addition, a number of additional releases of fuels or solvents from accidents may have resulted in spills within the corridor.

Finally, there may be OHM associated with historic operations of the rail lines, including release of fuels or combustion products (total petroleum hydrocarbons and polycyclic aromatic hydrocarbons) and materials associated with application of pesticides, herbicides, or wood preservative (metals and polychlorinated biphenyls).

Based on a review of the DataMap reports, and on general knowledge of rail operations, OHM issues that may be encountered along both the Worcester-Millbury-Grafton segment and the Ashland-Framingham segment include but may not be limited to the following:

- Petroleum hydrocarbons
- Polycyclic aromatic hydrocarbons (PAHs)
- Asbestos
- Polychlorinated biphenyls (PCBs)
- Volatile organic compounds (VOCs), including chlorinated solvents
- Metals

Measures for management of OHM are addressed in Section 7.10.

Table 4—Listed Sites in Ashland-Framingham Segment

Database	Updated	Radius (miles)	Site	1/8 mile	1/4 radius	1/2	1/2>	Zip	Totals
NPL	10/7/2005	1	0	0	1	0	0	0	1
CERCLIS	10/7/2005	0.5	0	2	0	3	-	0	5
NFRAP	8/1/2005	0.25	0	0	1	-	-	0	1
RCRA TSD	9/22/2005	0.5	0	0	0	0	-	0	0
RCRA COR	9/22/2005	1	0	0	0	0	0	0	0
RCRA GEN	6/13/2005	0.25	0	9	1	-	-	3	13
ERNS	12/31/2004	0.25	0	5	1	-	-	6	12
STATE SITES	9/16/2005	1	0	6	2	6	11	3	28
SPILLS-1990	9/16/2005	0.5	0	20	11	23	-	13	67
SWL	4/6/2005	0.5	0	0	0	1	-	0	1
REG UST/AST	11/4/2005	0.25	0	3	3	-	-	2	8

Source: FirstSearch Technology

Table 5—Listed Sites in Worcester-Millbury-Grafton Segment

Database	Updated	Radius (miles)	Site	1/8 mile	1/4 radius	1/2	1/2>	Zip	Totals
NPL	10/7/2005	1	0	0	0	0	0	0	0
CERCLIS	10/7/2005	0.5	0	0	0	0	-	0	0
NFRAP	8/1/2005	0.25	0	0	0	-	-	0	0
RCRA TSD	9/22/2005	0.5	0	0	0	1	-	0	1
RCRA COR	9/22/2005	1	0	0	0	1	1	0	2
RCRA GEN	6/13/2005	0.25	0	22	19	-	-	2	43
ERNS	12/31/2004	0.25	0	10	1	-	-	21	32
STATE SITES	9/16/2005	1	1	18	15	22	47	7	110
SPILLS-1990	9/16/2005	0.5	3	66	64	111	-	69	313
SWL	4/6/2005	0.5	0	0	0	0	-	4	4
REG UST/AST	11/4/2005	0.25	0	18	15	-	-	1	34

Source: FirstSearch Technology

6. Proposed Track Improvements and Design Options

6.1. Overview of Track Improvements

6.1.1. Description of Ashland-Framingham Segment

In Framingham, the proposal is to extend the Third Iron west (from CP23) towards Ashland to the existing universal crossover interlocking at CP24 and establish a new connection to Track 1 at that point. That would allow even the longest trains to pull completely off the Main Line while assembling train sets in Nevins Yard, minimizing potential interference with the passenger operation. These freight train movements for assembling train sets can occupy up to more than a mile of track. Two options were evaluated for the connection near CP24 in Ashland: Option 1 would tie in east of the Main Street grade crossing and Option 2 would extend west towards CP24.

Available right-of-way is generally on the south side of the tracks in Ashland-Framingham, so the track addition would be accommodated on the south side of the existing tracks. Track 1 now occupies the outbound (north) side, and Track 2 occupies the inbound (south) side. In the future, the added track on the south would be designated as Track 2, accommodating inbound trains, existing Track 2 would become Track 1 (accommodating outbound trains), and the existing Track 1 on the north would accommodate all freight movements from Nevins Yard for assembling train sets. Through freight movements would still be accommodated on Tracks 1 and 2, but freight movements for assembling trainsets, which can occupy the track for a few hours at a time, will be entirely shifted to the northern freight lead. In terms of noise and other issues, there would be no perceived change from this modification. Trains would continue to switch cars back and forth but generally on the separate, adjacent lead track instead of the Main Line.

6.1.2. Description of Worcester-Millbury-Grafton Segment

The proposed change at Worcester is to provide a third track east of CP43 all the way to CP39 in Millbury/Grafton. This will alleviate the need for CSX to occupy Main Line Track 2 at Worcester and allow MBTA and Amtrak trains to have double track all the way to CP44. In the Worcester area, both sides of the right-of-way are constrained, and the east end yard lead on the south side of Tracks 1 and 2 will be extended, with the track addition on the south side along most of this project segment. Where other constraints exist at bridge crossings, all three tracks would be relocated.

Along this segment, with the track addition, the freight movements for assembling trains could all be accommodated on the southernmost track, and designations for existing Tracks 1 and 2 will remain the same. These Main Line tracks (Tracks 1 and 2) will continue to accommodate through movements of MBTA rail passenger cars, Amtrak inter-city service, and through freight traffic. Additionally, in Worcester, CSX has asked for an extension of the east freight track yard lead approximately one-half mile to allow simultaneous moves to and from the intermodal yard. This lead should tie in east of the new crossover from Track 2 to the east end yard lead, which accommodates traffic to and from the intermodal yard. This will allow simultaneous moves to the Worcester Yard and intermodal tracks.

To the adjacent observer, nothing will change. The CSX trains currently using Track 2 will simply be 13 feet away on the new parallel track. Use of the 13-foot track centers were assumed in this design report, due to the constrained nature of the right-of-way in the Worcester-Millbury-Grafton segment and will require approval from CSX. At CP39, a lefthand crossover will be added to provide a full universal crossover and operational flexibility to access all tracks in both directions.

6.1.3. General Description of Alignment and Configuration

The new track for its entire length would be constructed of new continuously welded rail on resilient fastener tie plates with new wood ties and ballast. In some areas the existing track will be lined over and, with some minor upgrades, surfacing, and aligning, will be brought up to new track standards. All tracks will be constructed to CSX standards. The type of track construction is further discussed in the construction sections. Similarly, all turnouts and crossovers will be constructed with new materials meeting CSX standard requirements. For the actual construction of the project, CSX will determine what tracks might be constructed by a contractor versus CSX forces.

A major concept envisioned for adding the third track while minimizing disruptions to operations, utilizing the existing available right-of-way and not creating many new curves, is to perform track alignment transitions within curves. For example, in Framingham, the available right-of-way is on the south side of the track, but the track from Nevins Yard allows extension of the northern yard lead (Third Iron). From Nevins Yard, the transition to the track addition to the south occurs in the curve area at CP23, with relocation of the existing tracks over a distance of roughly 1,270 feet. This takes advantage of the existing curves and with minor modifications and transitions into the new alignment going in approximately the same direction, effectively transitioning from one track center to the adjacent track center.

Another consideration with the change or addition of a third track will be to maintain service to the existing consignees or CSX customers. As the project develops, coordination will be performed with CSX and the customers to schedule outages for performing track and related changes. For the most part, these changes should be able to be scheduled so that service to customers is not disrupted anymore than traditionally scheduled maintenance for the line. A list of existing connections, sidings, and consignees along with the type and level of service is included on Table A-3.

It is important to note that, in many of the areas where the location of a third track is recommended, the existing space is being used as a maintenance access road. This access road will, in many instances, no longer be available once the additional track is constructed. This will, to some degree, restrict CSX's ability to access areas for the purposes of inspection and maintenance, and CSX approval will be required for use of these areas.

6.1.4. Changes in MBTA Commuter Rail Operations

With the addition of the third track, more frequent headways can be accommodated on the Framingham/Worcester Line on the segment extending from Framingham west to Worcester. At present, there are 10 inbound trips from Worcester to Boston, and 10 outbound trips from Boston to Worcester. The current MBTA Framingham/Worcester Line schedule for trains to and from Worcester, Framingham, and Boston is shown on Table A-2.

The CSX study recommending the 6.5 miles of track improvements indicated that this level of improvement would be needed to accommodate four additional midday trains (two round trips) per day. At present, 20 trains a day (10 daily round trips) currently operate between Boston and Worcester, and the remaining 20 trains (10 daily round trips) that service Framingham turn back and return to Boston. With the proposed track additions, some of these train cars that now turn back in Framingham could potentially continue west to Worcester. The amount of additional commuter trains extending west of Framingham to Worcester will be determined by negotiations between the MBTA and CSX.

6.2. Track Improvements by Segment

The proposed track improvements, design options in certain segments, and assessments of each location are discussed in more detail below, from west to east for each project segment.

6.2.1. Description of Ashland-Framingham Segment

6.2.1.1. CP24 – Proposed Track Installation

The original CSX study indicated that the proposed third track should tie in at CP24. Tying in at an existing CP location would maximize the track lead length and from a signal perspective, would reduce the signal-related costs by tying in at an existing interlocking. However, this would require an additional track in the grade crossing at Main Street in downtown Ashland. It would appear that if tying in east of the Main Street grade crossing were acceptable from a CSX perspective, then eliminating the extra track and the grade crossing would be a better approach. This is especially true from the public's perspective. There would be less disruption during construction, as the grade crossing would not be impacted. During train operations, trains would not be tying up the grade crossing, while waiting for a signal to enter the Main Line at CP24. For the purposes of this study, two options were considered for the western tie-in downtown Ashland:

- **Option 1:** The first design option involves tying into Track 1 with the Number 20 lefthand turnout east of Main Street, thus eliminating all conflicts with the existing grade crossing.

- **Option 2:** The second option involves tying in at a location between Main Street and Cherry Street. Adding the third track west of Main Street will involve greater property impacts as the right-of-way becomes constrained west of the crossing.

Option 1, which involves tying in to the third track to Track 1 with the Number 20 lefthand turnout east of Main Street grade crossing, is identified as the preferred design option for further consideration. CSX agreement to terminate the track east of Main Street will be needed.

6.2.1.2. Milepost 24.10 – Curve

This location is the start of a lefthand curve facing east. Beyond this curve to the east, the existing right-of-way has additional space for a third track on the south side. This is the area currently used as a maintenance access road by CSX.

It is recommended that right-of-way established by the existing curve be used, so that the tracks swing from left to right, thus effectively creating the addition of the third track on the south side of the right-of-way. This area currently has a CSX maintenance road that can be used to locate an additional track, thus better utilizing the available right-of-way. Again, CSX agreement on the use of this maintenance road for the track location will be required.

6.2.1.3. Milepost 23.83–Sudbury River Bridge (West)

This bridge structure has adequate width for the addition of a third track on the south side. With the possible addition of a short ballast retaining wall, no other track-related modifications are expected.

It is recommended that a short ballast retaining wall be installed.

6.2.1.4. Milepost 23.67–Fountain Bridge

The existing bridge appears to have adequate clearance for a third track on the south side. No additional bridge modifications are required at this location.

6.2.1.5. Milepost 23.54–Framingham Reservoir No. 2 Bridge, also known as Sudbury River Bridge (East)

Similar to Sudbury River Bridge (West) there is ample space on the south side to construct a third track and other than a short ballast retaining wall, no other track related improvements are required.

It is recommended that a short ballast retaining wall be installed.

6.2.1.6. Milepost 23.11 – Curve alongside Framingham Reservoir No. 2

This location is the start of a righthand curve facing east. At the east end of this curve is CP23 and the tie in of the existing 3rd Iron track

Similar to the curve at MP 24.10, all three tracks would begin to be lined over utilizing the existing curve to a point where the most northerly track ties into the existing 3rd Iron at MP 22.75. It is recommended that right-of-way in the existing curve be used so that the tracks swing from right to left, thus effectively creating the addition of the third track on the south side of the right-of-way. This area currently has a CSX maintenance road that can be used to locate an additional track thus better utilizing the available right-of-way.

This would require a slight modification to upgrade the turnout leading to the Fourth Iron on the south and the removal of the existing lefthand turnout to the 3rd Iron on the north.

- **Option 1:** Track addition on the north side, would involve work along the edge of Framingham Reservoir No. 2. This will require installation of a retaining wall to avoid work near the embankment adjoining the reservoir.

- **Option 2:** A design option would involve track realignments in this area to avoid work near the edge of the reservoir. The disadvantage of the track relocations is greater disruption to the existing CSX operations.

6.2.2. Description of Worcester-Millbury-Grafton Segment

Along this segment, there would be significant modifications required to accommodate the installation of a third track. This work would include: land takings, ledge removal, bridge modifications, major utility relocations, and numerous walls to mitigate some of the preceding. Many of the existing culverts would require further inspection, cleaning, upgrades or total reconstruction as well as extensions under the proposed track location.

6.2.2.1. Milepost 43.27 – East End of Worcester Yard

At this location, existing yard tracks would be upgraded and realigned to parallel the existing Main Line Tracks 1 and 2. Additionally, the existing east yard freight lead would be upgraded and realigned to parallel the new third track and tie into the third track with a new lefthand turnout just east of the existing lefthand crossover between Tracks 1 and 2 at CP43.

The proposed third track would include a new lefthand crossover to Track 2. The third track would continue east, parallel to Track 2, with the track centers separated by approximately 13 feet.

6.2.2.2. Bridge 42.78 – Plantation Street Bridge

This bridge spans two tracks and would require excavation of rock ledge to accommodate the proposed third track. Track would continue under Plantation Street Bridge on the south side with removal of existing ledge. Bridge modifications are discussed further under the *Bridge and Culvert* section.

6.2.2.3. Bridge 41.67 – Hamilton Street Bridge

Keeping the existing Main Line Tracks 1 and 2 in situ will require modifications to the existing ledge and west abutment of the bridge. There are two options in this location.

- **Option 1:** One option that this report addresses consists of modifications to ledge and the bridge abutment on the west side of the Hamilton Street Bridge, as well as replacement of the bridge superstructure.

- **Option 2:** Another design option to be investigated would use the existing curve under the Hamilton Street Bridge. This would consider a track swing which may negate or reduce any modifications to the existing bridge structure. The disadvantage of the track swing is that will require more disruption to the existing CSX operations.

6.2.2.4. Milepost 40.45 – Sack's Siding

The existing lefthand turnout off of Track 2 leads into the Sack Storage Facility, Inc. siding at Milepost 40.45. This siding will need to be relocated to ties into the new proposed third track location.

6.2.2.5. Milepost 40.30 – Curve

A lefthand curve facing east would allow a transition to the north side of the right-of-way to access the available open bay on the Route 20 Bridge. The tracks will be transitioned in this area to the east side of right-of-way to set up for crossing of the available span at Route 20, further to the south.

6.2.2.6. Bridge 40.23 – Sunderland Road Bridge

The existing bridge would require modification to accommodate the additional track. Due to the reduced overhead clearances on the west side of the bridge, track realignments are proposed to accommodate the additional track on the east side of the bridge. These realignments would also shift the added track on the east side further south to accommodate additions on the available east bay of the Route 20 bridge. At Sunderland Road, this would be a ballasted deck crossing of the road, however, widening of the bridge would be required. Available options to accommodate the track additions in this area are discussed under Section 6.4, *Bridges and Culverts*, which addresses modifications required of the bridge and bridge deck. Issues associated with the track addition on the east side of the bridge include new residential construction near, but outside, of the railroad right-of-way.

6.2.2.7. Bridge 40.10 – Camosse Siding

An existing lefthand turnout off of Track 1 leads into the siding on the Camosse Masonry Supply Company property. This turnout and siding will need to be relocated with the proposed track

improvements.

6.2.2.8. Bridge 39.92 – Route 20

The existing bridge includes an empty track bay on the north side. This would be a ballasted deck crossing of the road (refer to Section 6.4, *Bridges and Culverts* for modifications required of the bridge and bridge deck). The bridge deck would be upgraded to accept a new track crossing in the existing open bay on the north side of the bridge.

6.2.2.9. Milepost 39.75– Curve

A lefthand curve facing east would allow a transition to the south side of the right-of-way. The tracks will be transitioned to the south side of right-of-way with a tie in at approximate MP 39.50.

6.2.2.10. Bridge 39.80– CP39

CP39 is an existing single No. 20 righthand crossover. The proposed third track will be tied in to existing Track 2 with a new No. 20 lefthand turnout just east of the existing crossover. Also, a new No. 20 lefthand crossover will be installed just east of the new turnout. This effectively reconfigures CP39 as a universal crossover centered around a turnout to the proposed third track.

6.3. Signalization

As part of the proposed addition of a third track, the signal system will need to be modified and updated. A primary feature of the signal system is to regulate train movements on intersecting tracks at designated "Control Points (CPs)", commonly referred to as interlockings, to prevent collisions between freight and passenger trains, and control movements within each segment between CPs. The area between signal controls is referred to as a block.

The type of signal system currently in use along the Framingham/Worcester Line involves locomotive-based (cab) signal controls commonly known as a "Cab, No-Wayside" automatic block signal system. One major operational advantage to the use of this type of cab signaling system includes the ability to provide trains with continuous or ongoing notification of track conditions ahead, thereby increasing the efficiency and safety of railroad operations. This type of signal system consists of vital microprocessors within each interlocking and the continuous track-to-train transmission is accomplished through the use of Electrocode 4 (EC4) units coupled with Electro Cab units (cab signal generators) between interlockings. EC4 is an electronic track circuit that uses the rails to convey track, block and aspect information, both to opposing signal apparatus (interlocking or adjacent block) and cab-equipped trains. Interlockings are equipped with Harmon's Vital Harmon Logic Controller (VHLC) and are interfaced with the outlying track circuits by use of Electro Code Track Circuit Interface units.

6.3.1. Description of Ashland-Framingham Segment

The segment, between CP23 and CP24, is approximately 1.5 miles in length. The third track along this segment will extend the existing Third Iron between Nevins Yard at CP23 and CP24 and tie back into Track 1 at CP24. The Third Iron lead turnout from Track 1 into Nevins Yard will be retired as part of this project.

Two options are identified for tying the freight lead (Track 3) back into Track 1 near CP24. Both options call for a new Number 20 lefthand turnout, with the most significant difference being the configuration of the Main Street highway-rail grade crossing. Both of these options will incorporate the Cherry Street and Main Street highway-rail grade crossings within interlocking limits. Option 1 will place the switch approximately 130 feet east of Main Street, thereby keeping the AHCW ground equipment intact. However, Option 2 places the switch approximately 920 feet west of Option 1, or approximately 720 feet west of Main Street, increasing the number of tracks at the crossing from the existing two-track crossing to a three-track crossing.

This reconfiguration of both the interlockings and the additional track between will necessitate the following changes:

6.3.1.1. CP24 Modifications

The following signalization changes are required near the Ashland Main Street grade crossing, regardless of which of the two design options is chosen. Option 1 for tying in east of Main Street is the preferred option, over Option 2, which would add a grade crossing.

- Install new electrically operated switch with the new Number 20 lefthand turnout,
- Install electric snowmelters and control circuitry for three new switches,
- Install three new westbound signals east of Main Street Crossing,
- Programming changes required to the Vital Harmon Logic Controller, and relays incorporated into the control circuitry to accommodate the new Number 20 switch:
  - Programming changes to include aspect changes,
  - Local Control Panel changes,
- Incorporate Cherry Street grade crossing within interlocking limits,
- Incorporation of Main Street crossing within interlocking limits assumed for operational benefits,
- Two additional track circuits will be required on Tracks 1 and 2 to release circuitry to allow for follow-on moves and release of the crossing control circuitry,

- Due to reconfigured and increased length of the interlocking, install new Location "B" house with Vital Harmon Logic Controller complete with batteries, link to main VHLC, at east end of interlocking.

For the two design options:

- **Option 1**, which shows a new Number 20 turnout located approximately 130 feet east of Main Street crossing, Tracks 1 and 2 westbound governing signals would be relocated approximately 500 feet east of Main Street crossing on new cantilever with the Track 3 westbound signal.

- **Option 2**, with a new Number 20 turnout located approximately 720 feet west of the Main Street grade crossing, Tracks 1 and 2 westbound governing signals would be relocated approximately 50 feet east of Main Street crossing on new cantilever with Track 3 westbound signal.
  - Existing northeast quadrant Automatic Highway Crossing Warning equipment to be moved out to accommodate inclusion of third track,
  - New constant warning device (predictor unit) required.

6.3.1.2. CP23 Modifications

The modifications required at CP23 at the connection with the west end of Nevins Yard are outlined below.

- Retire existing turnout from Track 1 onto Third Iron,
- Reprogram the Vital Harmon Logic Controller (VHLC), and remove necessary associated switch relays from the control circuitry to accommodate the removal of the turnout:
  - Programming changes to include aspect changes
  - Local Control Panel changes
- Install new Electro Code Track Circuit Interface unit and new Electro Cab generator for new third track west to CP24.

6.3.1.3. Automatic Block Signal System

Each existing signal cut section between CP23 and CP24 will require the installation of the following equipment for use on the third track only:

- One new EC4 intermediate unit, codes to be CSX standard and similar to those of existing EC4 units on Tracks 1 and 2,
- Two new Electro Cab units.

6.3.2. Description of Worcester-Millbury-Grafton Segment

The segment, between CP39 and CP43, is approximately 4.3 miles. The third track along this segment will extend the existing yard lead eastward to CP39. The new track will tie back into Track 2 at CP39 by adding a new Number 20 lefthand turnout. Additionally, a new Number 20 lefthand crossover is proposed at CP39 adding to the existing crossover, thereby creating a universal interlocking with a turnout onto the new third track. All new turnouts will be complete with dispatcher-controlled electrically-operated switch machines.

The existing Worcester Yard lead switch in CP43 will be replaced by a lefthand crossover between Track 2 and the extended yard lead, and a new lefthand yard lead turnout will be required from Track 3 into Worcester Yard. The yard lead from Track 3 will be situated to allow for parallel moves from Track 1 to Track 2, and Track 3 into Worcester Yard.

This reconfiguration of both interlockings and the additional track between will necessitate the following changes:

6.3.2.1. CP43 Modifications

Modifications required at the CP43 and at connections to Worcester Yard are as follows:

- Install new electrically operated switch machine on new Number 10 lefthand turnout from Track 3 into Worcester Yard,
- Install new electrically-operated switch machines on new Number 10 lefthand crossover between Track 2 and Track 3,
- Install electric snowmelters and control circuitry for three new switches,
  - Upgrade the existing AC metered service to accommodate additional loads,
- Install new home signal governing eastward movements from Yard Lead to Track 3,
- Install new home signal governing westward movements from Track 3 through the interlocking,
- Reprogram the Vital Harmon Logic Controller, and install necessary relays into the control circuitry to accommodate the new turnout and crossover switches, and corresponding signals:
  - Programming changes to include aspect changes,
  - Local Control Panel changes,
- Install new Electro Code Track Circuit Interface unit and new Electro Cab generator for new third track west to CP43.

6.3.2.2. CP39 Modifications

Signalization changes required at the east end of this project segment, at CP39, consist of the following:

- Install new electric operated switch machine on the new Number 20 lefthand turnout from Track 2 to the extended yard lead,
- Install new electrically operated switch machines on new Number 20 lefthand crossover between Track 2 and Track 1,
- Install electric snowmelters and control circuitry for three new switches,
  - Upgrade the existing AC metered service to accommodate additional snowmelter loading requirements,
- Install new home signal governing eastward movements from the new yard lead to Track 2,
- Lengthen interlocking limits by relocating existing westbound home signals governing Tracks 1 and 2 eastward to include the new turnout and the new crossover,
- Reprogram the Vital Harmon Logic Controller, and install necessary relays into the control circuitry to accommodate the new turnout and crossover switches, and corresponding signals:
  - Programming changes to include aspect changes,
  - Local Control Panel changes,
- Install new Electro Code Track Circuit Interface unit and new Electro Cab generator for new third track west to CP43,
- Install new Location "A" house with Vital Harmon Logic Controller complete with batteries, link to main VHLC, etc.

6.3.2.3. Automatic Block Signal System

Each existing signal cut section between CP39 and CP43 will require the installation of the following equipment for use on the third track only:

- One new EC4 intermediate or EC4 repeater unit, codes to be CSX standard and similar to those of existing EC4 units on Tracks 1 and 2,
- Two new Electro Cab units,
- Sacks Siding lead and its associated circuitry will be relocated and incorporated from Track 2 onto Track 3.

6.4. Bridges and Culverts

The structures present along the Ashland-Framingham and the Worcester-Millbury-Grafton segments were inspected during the field walkover. These structures included a mix of bridges that carries railroad over roadways or river, or roadways over railroad, and drainage culverts under railroad. The structural modifications proposed to accommodate the track additions were identified, but this project did not address improvements to existing bridge clearances. These structures are described below, from west to east and by milepost, for both project segments.

6.4.1. Description of Ashland-Framingham Segment

6.4.1.1. Milepost 23.67—Fountain Street Bridge

This three-span (31'-9" 55'-0" 31'-9") steel bridge with concrete deck was rebuilt in 1998. The center span of this bridge extends over the two existing tracks. The proposed third track will be located on the south side of the existing tracks. It appears based on preliminary field measurement that there is enough width available between the southernmost track and the south pier of the bridge to accommodate the new track. Presently, the space along the track is used for maintenance vehicle access.

During the next phase of project development, it is recommended that the footing for the south pier of the bridge be evaluated for additional train loads, due to its close proximity to new track.

6.4.1.2. Milepost 23.83—Sudbury River Bridge (West)

This single-span bridge is composed of concrete encased riveted steel girders, with concrete deck resting on granite abutments. This approximately 42-foot long bridge carries two tracks over the Sudbury River. In 1911, the original bridge was widened at the south end with concrete superstructure and concrete abutments. The proposed third track will be located on the south side of the existing tracks. It appears based on preliminary field measurement that there is ample width available on the bridge to add the new track. Presently, this space along the existing tracks is used for maintenance vehicular access.

Structurally, the superstructure appears to be in satisfactory condition overall with some isolated concrete spalling. The existing south side wingwalls are beginning to show signs of movement and deterioration due to vegetation outgrowth. The slopes retained by these wingwalls are also showing signs of movement and failure. The construction of new track will require regrading and ballast. To contain this regrading and ballast, 2-foot high headwalls will be required at the ends of the culvert along the top soffit.

During the next phase of project development, a structural inspection should be performed to identify deteriorated concrete. This may include marine inspections as well. Repair concrete spalls and cracks and construct of 2-foot high headwalls at the ends of the culvert is recommended. In addition, reconstruction of the southeast and southwest wingwalls two feet higher than existing should be

performed. During the final design phase, a structural capacity check of the existing bridge for the train loading may be prudent. It is also suggested that concrete core samples be taken and tested to confirm the integrity and strength of the concrete deck.

6.4.1.3. Milepost 23.54–Bridge at Framingham Reservoir No. 2, also known as Sudbury River Bridge (East)

The original northern half of this bridge is a two-barrel stone arch culvert that was lengthened on the south side with the addition of a concrete arch in 1913. This bridge carries two active tracks over the Framingham Reservoir No. 2. The proposed third track will be located on the south side of the existing tracks. It appears based on preliminary field measurement that there is enough bridge width available to add the new track. Presently, the space along the track is used for maintenance vehicular access.

Structurally, this structure appears to be in satisfactory condition overall with minor isolated concrete spalling. To contain ballast and regrading for the new track, construction of 2-foot high headwalls at the ends of the culvert and on top of wingwalls will be required.

A structural inspection should be performed to identify deteriorated concrete. This may include marine inspections as well. Repair concrete spalls and cracks and construct 2-foot high headwalls at the ends of the culvert and on top of wingwalls is recommended. During the final design phase, a structural capacity check of the existing bridge for train loading may be prudent.

6.4.1.4. Culverts

During the field inspection, the locations for culverts at Mileposts 24.08, 23.36, 23.23, and 23.10 in Ashland were examined. These four culverts could not be seen, but, according to Conrail data, consist of the following:

- **Milepost 24.08 – Culvert –**3’-6”x3’-0” stone box culvert with about 4-feet of earth cover that is located west of the Ashland Technology parking lot and east of the former Ashland rail station.
- **Milepost 23.36 – Culvert –**3’-0”x3’-0” stone box culvert with about 3.5-feet of earth cover that is located east of the Framingham Reservoir No. 2 Bridge.
- **Milepost 23.23 – Culvert –**1’-6”x1’-6” stone box culvert with about 6-feet of earth cover that is located further to the west of Framingham Reservoir retaining wall.
- **Milepost 23.10 – Culvert –**2’-0”x1’-6” stone box culvert with about 8-feet of earth cover that is located west of proposed retaining wall along Framingham Reservoir No. 2.

These culverts have either been covered up or may have been obscured with fallen leaves and vegetation. Based on field observation, it appears that the new track could be accommodated largely on existing graded areas alongside the existing tracks. One other culvert at Milepost 22.94 would be affected by the track additions between Main Street and Framingham, for a total of five culverts affected, assuming Option 1, for tying in east of Main Street. is the preferred option. Option 2, which is not recommended, would affect a sixth culvert at Milepost 24.39 west of Main Street. These two other culverts are:

- **Milepost 24.39 – Culvert –** 18 inch-diameter cast iron pipe is located west of Cherry Street.
- **Milepost 22.94 – Culvert –** 3’-0”x2’-0” cast iron pipe discharges north into Framingham Reservoir No. 2.

It appears from field observations that the culverts along the Ashland-Framingham project segment do not need to be lengthened. Presently, the space along the track is used for maintenance vehicular access, and the area is graded to accommodate the track addition on the south side.

For Milepost 23.23 and 23.10 culverts, considering the small size of these culverts and the large earth cover, barring any structural deterioration or damage, the culvert should be strong enough to carry train loading. However, since the culverts at Mileposts 24.08 and 23.36 are of a larger size and have less earth cover, they should be inspected and their strength verified. For the culverts at Milepost 24.08 and 23.36, it may be prudent to perform a structural capacity check for train loading during the final design phase. All culverts along this project segment should be visually inspected to check for any structural deficiencies.

6.4.2. Description of Worcester-Millbury-Grafton Segment

6.4.2.1. Milepost 43.31–Putnam Lane under Railroad

This bridge that carries the tracks over Putnam Lane was in 1911 and widened in1912. The structure consists of a riveted steel plate girder superstructure with granite block and reinforced concrete abutments built. The center portion of the bridge was constructed in 1911 and is a simple span supported by granite block abutments. The widened portion of the bridge was constructed in 1912 and is a three-span continuous structure with reinforced concrete abutments and steel piers. The steel piers are located on both sides of the granite block abutment that was constructed as part of the 1911 bridge. The north steel pier caps bear on the reinforced concrete side wall of the 1911 abutment at one end, and they are framed on top of single columns at the outer end. The south steel pier caps bear on the reinforced concrete side wall of the 1911 abutment at one end, and they are continuous over four columns in the southerly direction. The roadway under the bridge consists of a single lane with a vertical clearance of 11’-10”. The approach roadways on either side are wider than the bridge underpass.

Presently, the track configuration on the bridge includes two main tracks (eastbound and westbound) on the northerly end and a side track on the southerly half. The 1912 bridge plans show five tracks minimum, possibly six tracks. The proposed new track will be located in the space between the two existing main tracks and the existing yard lead. This aligns the new track roughly over the center narrow

portion of the bridge that was constructed in 1911. The narrow portion of the bridge was specifically designed for two tracks on this specific alignment.

Based on the field evaluation, it appears that the bridge superstructure steel is in good condition. The concrete deck slab was not entirely visible due to the close spacing of steel beams. The northeast corner of the east abutment of the bridge has large concrete spalls. It appears that the masonry leveling course at the bottom of the east bridge abutment has lost several masonry pieces, resulting in the large granite blocks being undermined and some settlements of the joints.

During the final design phase, it is recommended that a structural capacity check for train loading (standard Cooper E80 loading) be performed using the data from the latest bridge inspection report. Our preliminary analysis for the short beams (without section losses) indicates that these six beams under the tracks could handle the train live (Cooper E80) loading. The proposed track in the narrow portion of the bridge must be centered on the six heavier 15" I-beams (Bethlehem Steel 104#). If for some reason, this alignment is not suitable, then the lighter beams (15" Bethlehem Steel 73#) will require strengthening (new cover plates subject to weldability) in order to handle the train (Cooper E80) live load. Before installing the new track, the bridge deck and waterproofing membrane on the deck should be inspected. Any deterioration found should be repaired. The deteriorated concrete at the northeast corner of the east bridge abutment should be repaired. It is recommended that all joints be inspected and repointed, as necessary. At the east abutment, all loose masonry pieces at the base of the abutment should be removed, and the space hand cleaned. Casting a concrete curb along both abutments is recommended. This will have a two-fold advantage, one it will help in supporting the main granite blocks, and two it will it provide curb section for the traffic. Application of concrete penetrant to the substructure concrete elements is also recommended.

6.4.2.2. Milepost 42.78–Plantation Street over Railroad

This structure carries two lanes of Plantation Street over the railroad. This structure consists of a single-span riveted steel plate girder bridge with concrete deck. The concrete deck was replaced in 1998. The bridge substructure elements consist of concrete abutments and wingwalls that rest on rock ledge. From visual field evaluation, this bridge appears to be in satisfactory condition.

The proposed track will be located between the southernmost existing track and the south bridge abutment. It appears based on field measurement that there is enough space available to install the proposed track. However, a portion of the rock ledge in front of the south abutment will need to be removed to clear the required railroad clearance envelope.

During the final design phase, it is recommended that a geotechnical testing program be undertaken to evaluate the rock outcrop in front of the south bridge abutment and to propose rock strengthening measures such that the structural integrity of the abutment is maintained.

6.4.2.3. Milepost 41.67–Hamilton Street over Railroad

This bridge carries two lanes of Hamilton street over the tracks. The bridge superstructure, built in 1993, is composed of 54'-11"± single-span pre-stressed-concrete butted box beams. This bridge spans over two existing railroad tracks. The substructure consists of original granite block abutments which are founded on rock ledge. This bridge has a 40-foot wide roadway with an 8-foot sidewalk. The bridge carries 8-inch and 12-inch gas lines plus a 12-inch water line.

The proposed track will be located on the west side of the existing tracks. From preliminary field measurement, it appears that there is about 16 feet available between the existing tracks and the west bridge abutment. This is not enough space to accommodate the proposed track with curved alignment with the required horizontal clearance. In order to install the proposed track, the west abutment has to be relocated approximately 10 feet minimum further west to get the required additional space. This 10 foot distance may increase depending on the amount of rock ledge that is required in front of the abutment to make the abutment stable and to accommodate the design of the abutment toe. The bridge superstructure will also require redesign and replacement, as abutment relocation would put the box beam (BI-48 Modified) sections at their upper design limit. It would be advantageous to keep the abutment widening within 10 feet from the butted box beam, as it would keep the box beam section dimensions the same as existing, thus minimizing impacts to bridge approach roadways grades and the east abutment. The wingwalls will also need to be redesigned, based on the regrading required at the west abutment. During the final design phase, it is recommended that a geotechnical testing program be performed to evaluate the rock ledge and to propose recommendations for rock stabilization.

As an alternative to bridge lengthening, it may be possible to accommodate the proposed track, the two existing tracks, and the required horizontal clearances by altering the horizontal alignment of all tracks and making them tangent within the footprint of this bridge. This option may be more costly than the abutment relocation due, to the large amount of rock removal required to accommodate the track alignment. Additionally, this option would create track alignments that are acceptable, but less than optimal. This would also require a greater disruption in rail traffic, with realignment of the two existing tracks. This option could be further evaluated in the final design phase.

In order to minimize automotive traffic inconvenience, the bridge construction will have to be done in stages. The bridge reconstruction is assumed to require staged construction with similar configurations as the 1993 construction project. The 8-inch and 12-inch gas lines, plus the 12-inch water line will have to be maintained during reconstruction of this bridge.

6.4.2.4. Milepost 40.23–Sunderland Road over Railroad

This single-span concrete arch bridge presently carries the two tracks over Sunderland Road. The proposed track will be located on the north side of the existing tracks. Since this bridge is just wide enough to accommodate two tracks, the addition of the third track would require this bridge to be widened by approximately 14 feet. Due to aesthetic reasons, the widened portion of this bridge will need to have similar concrete arch shape and color to match the existing bridge. In addition, new retaining walls would be required on both east and west approach to contain the widened embankments within the railroad right-of-way.

A residential property is located right on or near the railroad right-of-way at the northeast corner of the bridge. A portion of this property may be temporarily impacted during the proposed bridge construction activities.

As-built drawings for this bridge could not be located. The field visit to this bridge indicates the bridge to be in fair condition. The underside of the bridge arch shows concrete spalls, concrete honey combs with exposed reinforcement, and vehicle impact damage due to substandard vertical clearance (10'-6" at curbs, 12'-10" in the middle) over the roadway below. The roadway underneath has rising grade going from north to south on Sunderland Road resulting in the south end of the arch having the critical vertical clearance. This is where most of the vehicle impact damage can be found. The vertical alignment of Sunderland Road is tied to roadway intersections on either side that are not too far from this bridge. Sunderland Road is wide enough to carry four lanes of traffic, but with varying vertical clearance.

The widening is proposed for the north side of the bridge, due to substandard vertical clearances that are lower on the south side of the bridge. Another option to be evaluated in final design would involve lowering of the roadway profile to improve vertical clearances. This option would be costly, as it would involve roadway reconstruction.

During the final design phase, the existing arch bridge should be inspected and concrete strength tests should be performed. A structural capacity check for train (Cooper E80) loading is recommended using the data from the latest bridge inspection report and using concrete test sample results. All deficiencies should be repaired, such as spalls with exposed reinforcement, honey-combing with exposed reinforcement, and areas of vehicle impact damage. During bridge rehabilitation, care should be taken to clean and take measures to protect reinforcement steel from future progressive corrosion. Application of concrete penetrant on the entire underside and sides of this bridge is also recommended.

Staged construction is proposed to reduce impacts to traffic on Sunderland Road. A traffic maintenance plan will be required. The construction activities must minimize adverse impacts to the adjacent properties.

Improvements to vertical clearance signage are recommended to make them more visible, perhaps locating them on the bridge fascia. Roadway stripping can also be utilized to this effect. The illumination under and around the bridge should also be reevaluated.

6.4.2.5. Milepost 39.92–Route 20 over Railroad

This bridge carries the railroad over U.S. Route 20, a four-lane divided highway that is locally referred to as the Southwest Cutoff. This bridge was built in 1931 and consists of a two-span riveted steel plate girder bridge with 13-inch thick concrete deck. The bridge substructure elements consist of concrete gravity-type abutments and wingwalls. This bridge was originally designed to carry four tracks. Presently, the bridge carries two tracks on the westerly half of the bridge deck. The proposed third track will be located on the easterly half of the existing tracks. There is enough width available between the easternmost track and the east parapet to accommodate the new track. Presently, this space along the tracks appears open. Even though the bridge itself is wide enough for the new track, however, the northeast and southeast approach embankments will need to be widened. This embankment widening will require installation of new retaining walls (see Section 6.8, *Retaining Walls and Rock Slopes*).

The underside of this bridge was not visible for inspection due to the presence of netting installed to prevent spalling concrete from falling onto Route 20 below. The top side of the deck appeared to be in satisfactory condition. The concrete abutments and piers exhibit concrete cracking and efflorescence.

During the final design phase, it is recommended that a structural capacity check for train (Cooper E80) loading be performed using the data from the latest bridge inspection report. Before installing the new track, the bridge deck and waterproofing membrane on the deck should be inspected. Any deterioration found should be repaired. Substructure elements should also be inspected, tested, and repairs made to them, as necessary. Application of concrete penetrant to the substructure elements is recommended.

6.4.2.6. Culverts

During the field inspection, some of the fourteen culverts along the Worcester-Millbury-Grafton project segment could be observed, while others were obscured by fallen leaves or debris. The culverts along this project segment, according to review of Conrail data, are as follows:

- **Milepost 42.61 Culvert –** 24"x 30" stone box culvert north of Wells Street.
- **Milepost 42.56 – Culvert –** 36"x 24" stone box culvert north of Wells and Solferino Streets.
- **Milepost 42.15 – Culvert –** 42"x 42" stone box culvert that connects to drainage on lowlying areas of the Ecotarium property.
- **Milepost 41.89– Culvert –** 36"x 30" stone box culvert with north of the North High School property
- **Milepost 41.57 – Culvert –** 16-inch cast iron pipe south of Lake Park.

- **Milepost 41.45 – Culvert –** 36"x 40" concrete pipe south of Lake Park.
- **Milepost 41.08 – Culvert –** 36"x 24" stone box culvert north of the Perkins Farm Conservation Area.
- **Milepost 40.96 – Culvert –** 24"x 24" stone box culvert north of the Perkins Farm Conservation Area.
- **Milepost 40.51 – Culvert –** 24" x 24" culvert that discharges from the Sacks Storage Facility in the vicinity of Pond 2.
- **Milepost 40.14 – Culvert –** 48"x 54" stone box culvert that is west of the Southwest Commons Mall property.
- **Milepost 39.91 – Culvert –**24"x 24" stone box culvert near the Route 20 Bridge.
- **Milepost 39.77– Culvert –** 24"x 24" stone box culvert that connects to the pond east of the Route 20 Bridge.
- **Milepost 38.88 – Culvert –** 20-inch cast iron pipe north of the Wyman-Gordon Industrial Area.
- **Milepost 38.80– Culvert –** 24-inch cast iron pipe north of the Wyman-Gordon Industrial Area.

All culverts along this project segment will require lengthening or modifications to accommodate the third track addition. The modified sections of the culverts shall be designed for the train (Cooper E80) loading. It is recommended that all existing culverts be inspected for structural deficiencies and cleaned. A structural capacity check of existing culvert sections for train (Cooper E80) loading is also recommended.

6.5. Cross-Sections

The Ashland-Framingham portion of the project will not require substantial amounts of excavation, since the proposed location of the third track is currently graded in most areas and is used as an access road alongside the tracks. The Worcester-Millbury-Grafton segment of the project is more constrained, and the existing tracks are bordered by steep ledge cuts or embankment slopes in a number of locations.

Selected cross-sections of the third track segment east of Worcester were developed for the purpose of quantifying earthwork, identifying where additional right-of-way may be necessary and as an aide in determining the location and limits of retaining walls. The interval and specific locations were chosen to provide a representative sampling of conditions along the route and at significant changes in the extent of cuts and fills. The cross-sections are shown in Figures 15A through 15C

The proposed cross-section for the new third track was set at the same elevation as existing tracks and at 13 feet laterally from centerline of the existing Track 2. This dimension was chosen as a compromise between the existing track centers of 13 feet or less and a more desirable value of up to 17 feet. The steep cuts and fills that currently exist within most of the corridor combined with ongoing development immediately adjacent to the right-of-way mandates track centers not significantly greater than existing track separation (between Track 1 and Track 2). Agreement with CSX on the track center spacing will be required to verify the assumptions used in the track layout and design.

Initially, the proposed cross-section was developed very conservatively with full ditch sections in cuts. Widening in rock cuts initially assumed relatively flat back slopes with benching every 12 feet vertically. The initial conservative approach to the proposed cross-section was then modified due to significant impacts on adjacent properties, including buildings, and the need for property acquisition. The modified cross-sections eliminated the ditch in most cut sections and everywhere in rock cut. An underdrain was assumed in place of the ditch, and a back slope starting 12 feet from the centerline of the new track was assumed in rock cuts and a face of wall at 12 feet from track centerline where required at track level. In rock, a 1 on 4 back slope was assumed without benching. It is possible that these steeper slopes may require treatment methods of stabilizing the rock face. The location of rock in many locations is obvious, but less so in many other locations. The initial assumptions as to the presence, depth to rock, and its engineering characteristics may result in more or less retaining walls than depicted.

In many locations, the rock at the top of the cuts is overlain with varying depths of overburden, often sloping downwards towards the railroad. As a result, many of the retaining walls in cuts are at the top of the assumed rock line. These walls are necessary to prevent the overburden back slope from undermining adjacent properties and, in some cases, buildings. These walls would have to be keyed into the rock surface and anchored by means appropriate to the actual condition of the rock. Since the exact nature of the rock and its depth cannot be determined at this preliminary level of investigation, more or less additional property and potential impacts to adjacent properties are possible.

If the alternative of a new third track east of Worcester is pursued, additional investigations should be undertaken at many locations where the nature of and depth of rock is critical to contain the construction within the limited existing corridor.

6.6. Bedrock Excavation Methods

Bedrock excavation will be required to add a third track in the Worcester-Millbury-Grafton portion of the project. There are substantial areas of ledge adjoining the tracks in this project segment, as discussed in Section 5.5 and shown in Figures 14A-14X. The Ashland-Framingham portion of the project will not require considerable bedrock excavation.

The bedrock is a hard, slightly to moderately weathered, moderately fractured to sound, slightly fissile, dark brown, fine grained, mica schist, with moderately close, tight, shallow dipping joints. The bedrock appears massive and in many areas is free standing at near vertical angles.

Due to very limited room between the existing tracks and the existing rock face, and the need to keep the tracks in operation during construction, bedrock excavation methods will need to be performed from the top of slope down to the bottom, working within the existing right-of-way. Access to the right-of-way will need to be from adjacent streets or private property. Significant tree clearing and grubbing will be required before the rock excavation work can begin. Access roads will also need to be created to allow equipment to travel along the right-of-way.

Typical rock excavation methods include drilling and blasting, where the drill holes would be spaced approximately 5 feet on center. Normally the depth of the drill holes would extend about 1 foot deeper than the proposed bottom of excavation. However, it may not be possible to sufficiently control the movement of the rock using this method such that the blasted rock does not end up covering or fouling the track. Therefore, it may be necessary to break up and excavate the rock in lifts using more controlled methods such as hydraulic splitting or expansive grout. With these methods, drill holes would be spaced about 1 foot on center and extend to a depth of about 4 to 5 feet per lift. Hydraulic splitting is accomplished with mechanical equipment, whereas expansive grout could be placed in the drill holes and allowed to work overnight to break up the rock so that it could be excavated the following day.

Based on a very limited site reconnaissance, it is anticipated that the rock slopes can be excavated at near vertical slope of 1H:10V along the right-of-way with the toe of slope at least 14 feet from the centerline of the proposed third track.

Rock bolting may be required at approximately 20 percent of the excavated rock slope areas to provide additional support. The rock bolts would consist of 10-foot-long, 1.5-inch-diameter steel bars grouted in place and spaced approximately 15 feet on center. Permanent rock netting could also be used across the face of the rock slope where jointing or fracturing is more severe. Excavating the rock at a 1H:10V slope, and using rock bolts and netting would limit the amount of rock that would need to be excavated and reduce impacts outside the right-of-way. The locations where rock slopes (occasionally with rock bolts) and soil nails are recommended, rather than retaining walls, are designated as Areas X1 through Area X11, as discussed under Section 6.8, *Retaining Walls and Rock Slopes* and as shown in Figures 14A-14X.

6.7. Overburden Slope Protection

Where soil overburden slopes are exposed and are steeper than 2.5H:1V and up to 1H:1V, the slope could be treated with 8-inch minus rock fill covering a layer of nonwoven geotextile anchored into the slope. A 5-foot wide horizontal bench should also be provided, where space allows, at the top of the rock slope in the overburden soils to limit raveling of the soils.

A permanent soil nail wall could also be used to support soil slopes that need to be excavated along the alignment, such as in the vicinity of the Sack Storage, Inc. facility. The advantages of using a soil nail wall would be that the wall can be installed from the top down as the excavation progresses, without the need for additional excavation to construct a footing if a reinforced concrete wall was installed.

Additional information on the depth to groundwater and the soil conditions would be needed to design this type of wall.

6.8. Retaining Walls and Rock Slopes

Reinforced cast-in-place retaining walls are incorporated into the design where they are required and/or where they may be preferable to avoid property or environmental impacts or slope easements. The proposed track alignment, existing conditions and grades, and right-of-way locations are variables that help to determine where retaining walls are located. A conservative approach to locating retaining walls was taken to minimize or avoid property or environmental impacts wherever possible. This did not take into account the type of property or sensitivity of use, but retaining walls were assumed wherever the property lines were close to the tracks and proposed slopes, unless rock slopes could be excavated. During subsequent design phases, locations of retaining walls should be reviewed to determine whether property takings and slope easements would provide cost savings without incurring substantial impacts.

The retaining walls are labeled Type A, B and C to reflect their size. Type A retaining walls have wall stems that are 10 feet tall. Type B and C are similarly labeled to designate 15-foot and 20-foot tall wall stems, respectively. The numerical second digit in the retaining wall labels merely helps locate them as one travels from west to east along the track alignment. The retaining structures incorporate stocky stem walls (the back face of the stem walls are battered at a 3 to 1 slope to help offset the significant lateral surcharge forces produced by train loads where applicable). When supporting train surcharge loads, the retaining wall structures also require shear keys below the slabs to ensure their sliding stability. Along the limits of the retaining walls, temporary earth support walls are often required to either support adjacent live tracks or rising grades, while excavation cuts are dug to allow space for retaining wall construction. At some locations, sheet piling alone can support the temporary lateral loads, but when excavation cuts are required in the vicinity of existing tracks, the temporary walls will need to be stiffened. In certain critical cases (Wall Type C3 for example), the final design may need to investigate staged construction and temporary track outages to most efficiently construct the proposed third track.

Soldier pile and lagging walls (Type S) are also used. Since these wall types are particularly narrow and require no spread footing, they can be used when there is only a few feet available to install a retaining structure. This is particularly useful at numerous locations on this project, where right-of-way limits are close to the proposed tracks. A percentage of these piles will have to be drilled in place due to the presence of relatively shallow bedrock.

6.8.1. Ashland-Framingham Segment

A reinforced cast-in-place retaining wall is incorporated into the design to avoid or minimize incursion into the embankment along Framingham Reservoir No. 2 (see Figure 13I). The proposed track alignment, existing conditions and grades, and right-of-way locations are variables that help to determine where retaining walls are located. The retaining wall is labeled Type B to reflect its size. Type

B retaining walls have wall stems that are 15 feet tall. The retaining structure incorporates a stocky stem wall (the back face of the stem wall is battered at a 3 to 1 slope to help offset the lateral train surcharge forces). A shear key is also required for stability due to train surcharge loads. Temporary sheet piling is also required to support adjacent live tracks while excavation cuts are dug to open space for retaining wall construction. This wall is 250 feet long and it is centered about MP 22.80.

6.8.2. Worcester-Millbury -Grafton Segment

The individual retaining walls and rock slopes proposed are described below, from west to east.

Walls A1 and B1 stabilize the rising rock cuts adjacent to the proposed third track approaching and in the vicinity of Tampa Street. Since property lines are so close to the track in these areas, it may not be possible to cut rock slopes without going beyond right-of-way. Traditional-type retaining walls located as close to the proposed third track as possible can be constructed in this area and not go beyond the right-of-way. A few feet of backfill would be placed between the remaining rock and wall to help prevent future heaving of the walls. Note that it is also quite possible that the existing rock could be excavated at a steep slope here without impacting the right-of-way. For now, the estimate assumes retaining walls will be used in this location. These walls are approximately 100 feet and 130 feet long, respectively, and their centerlines are located at MP 43.02 and 43.00 (Figure 14D).

Rock slopes are proposed at **Areas X1**, extending east of Tampa Street, **Area X2**, extending south to Plantation Street, and **Area X3**, extending south of Plantation Street, and no retaining walls are recommended. The bedrock can be excavated at 1H:10V slope using various methods. Some rock bolting may be needed, with or without rock netting, to limit movement of rock and provide additional support. These three areas total approximately 1,590 feet and rock face heights vary between 30 and 35 feet (Figures 14D and 14E).

As the existing rock formations recede from the proposed third track alignment, **Retaining Walls C1, C2 and S1-a** are utilized to support existing soils adjacent to an industrial area. Wall C1 is 240 feet long with MP at 42.66, and Wall C2 is 100 feet long with MP at 42.63. Wall S1-a is 180 feet long centered on MP 42.59. Traditional cantilever retaining walls can be used in this area (Figures 14E and 14F).

Retaining wall A2 is approximately centered on MP 42.47, and **Wall S1-b** extends Wall 2A south by 130 feet to prevent excavation from extending beyond the right-of-way (Figures 14F and 14G). The 320-foot long retaining wall at Wall A2 is required for the limits where the proposed third track, south of the existing tracks, is nearest to the existing building. This building houses the Stagparkway Service Center off Wells and Solferino Streets. Building the proposed third track in this area requires that a retaining wall be used to support existing grades that are higher than the proposed track elevation. The retaining wall in this area will need to be located as close to the third track as possible in order for the structure to stay within right-of-way limits. Temporary support of excavation will also be required on the building side of the cut. Sheet piling is assumed but if shallow bedrock is encountered other methods of temporary support may be required.

Area X4 is located with its centerline at MP 42.34, and it is approximately 500 feet long. This wall would be installed to prevent takings within the Ecotarium property. No walls are recommended for this area. The bedrock may be excavated at 1H:10V slope using various methods. Rock bolting is not anticipated in this area. For these limits, existing rock formations are again within the footprint of the proposed third track and the right-of-way is only about 20 feet from the centerline of the track.

Where walls are required at the north end of the Ecotarium, the right-of-way is only approximately 14 feet from the proposed third track centerline. To avoid going beyond the right-of-way and still provide minimum clearance from the track centerline, a narrow vertical S Type (**Wall S1**) retaining structure can be implemented to retain lateral loads from the east. In this location, H piles spaced at approximately 8 to 10 feet on center with timber lagging and cast-in-place facing could be used. In this area, the piles will need to be drilled into the rock which may increase costs for this length of wall. After more analysis, a different wall type may be found to be more efficient for this area. This wall, Wall S1, is approximately 510 feet long with its centerline at MP 42.25 (Figures 14G and 14H).

Retaining wall A3 (600 feet long) is approximately centered on MP 42.14. This retaining wall is considered an alternate to requiring sloping easements at these limits. To adequately support the proposed third track, located to the west of the existing tracks, by fill alone would require the fill to extend beyond the right-of-way in this low-lying area at the Ecotarium. In places, the property lines are located within 15 feet of the centerline of the proposed third track. This area also includes Wetland A and utilizing a retaining wall may be more desirable than extending fill slopes into these sensitive areas. Sheet piling would be required to stabilize the existing tracks while the retaining wall A3 is constructed (Figure 14H).

Area X5 is located with its centerline at MP 42.07 and it is approximately 180 feet long (Figure 14H). It is adjacent to the Ecotarium property . For these limits, existing rock formations are again within the footprint of the proposed third track and the right-of-way is only about 20 feet from the centerline of the track. No walls are recommended for this area. The bedrock can be excavated at 1H:10V slope using various methods. Rock bolts are not anticipated to be needed this area to stabilize the face of the cut.

Wall S2 wall is approximately 440 feet long, with its centerline at MP 42.01 (Figure 14I). Where walls are required at the south end of the Ecotarium, the right-of-way is only approximately 15 feet from the proposed third track centerline. To avoid going beyond the right-of-way and still provide minimum clearance from the track centerline, this narrow vertical retaining structure can be incorporated. This wall will also avoid impacts on Wetland B. There is very little soil to retain in this area since grade is quite flat. However, to provide a barrier near the wetlands, H piles spaced at approximately 8 to 10 feet on center with timber lagging will be used. It is assumed that the piles will not need to be drilled through rock in this location.

Retaining wall A4 (130 feet long) is approximately centered on MP 41.96, and **Retaining Wall A5-a** is a 480-foot-long wall located to the south and centered approximately at MP 41.88. Retaining wall A4 is

considered as an alternate to requiring sloping easements within the North High School property, and retaining wall A5-a is proposed to avoid impacts to Wetland B, which is located at the base of the embankment slope on this property. To adequately support the proposed third track, located to the west of the existing tracks, by fill alone would require the fill to extend beyond the right-of-way in this low-lying area. The property lines are located within 15 feet of the centerline of the proposed third track. As grade drops off from the proposed track alignment, this wall keeps work limits away from the right-of-way and supports lateral loads from the train and associated soils. Sheet piling would be required to stabilize the existing tracks while this wall is constructed (see Figure 14I).

Retaining wall A5 (130 feet long) is approximately centered on MP 41.72, north of the Hamilton Street Bridge. Sloping cuts made in this area to construct the third track and drainage system would require the removal of soil beyond the right-of-way to produce a stable final grade, impacting adjacent residential properties, if retaining wall structures were not incorporated into the design. Sheet piling would be required to stabilize existing grades beyond the right-of-way while Retaining Wall A5 is constructed (see Figure 14J).

On both sides of Hamilton Street near residential properties, existing rock formations again creep into the footprint of the proposed third track alignment. No retaining walls will be required this area. Some rock bolting may be needed, with or without rock netting, to limit the movement of the rock face and provide additional support after it has been excavated at a 1H:10V slope. The rock excavation may be done by various methods. The rock face in this area is approximately 25 feet high and the length of this area (**Area X6**) is about 490 feet and it is approximately centered on Hamilton Street Bridge (MP 41.67) (Figure 14J).

South of this area, **Wall S3** is required to prevent excavation from extending beyond the right-of-way. This wall would be 235 feet long and would be centered on approximately MP 41.59.

Retaining wall B2 (220 feet long) is approximately centered on MP 41.45 in a low-lying area that includes Wetland C. This retaining wall is again considered as an alternate to requiring a sloping easement and impacting wetlands. Existing grades are well below the proposed track system elevation in this area. As fill is added to support the tracks, the limits of the sloping fill would go beyond the right-of-way unless a retaining wall is utilized. Temporary sheet piling would not be required at this retaining wall (see Figure 14K).

Area X7 is proposed adjacent to residential properties along the Orton Street Extension where existing rock is well into the third track footprint and right-of-way is about 20 feet from track centerline. Rock excavation, rather than retaining walls, is recommended for this area. Bedrock will be excavated at the typical 1H:10V slope using various methods which are outlined in Section 6.6. Some rock bolting may be needed to limit movement of rock and provide additional support for the rock face. Some areas of the rock bolted faces may also utilize rock netting. **X7** is 330 feet long and is centered at MP 41.35.

Retaining wall A6 (280 feet long) is approximately centered on MP 41.29 (Figure 14L). This retaining wall is also considered as an alternate to requiring a sloping easement. Sloping cuts made in this area to construct the third track and drainage system would require the removal of soil beyond the right-of-way to produce a stable final grade, if retaining wall structures were not incorporated into the design. Sheet piling would be required to stabilize existing grade beyond the right-of-way, while retaining wall A6 is constructed.

Area X8 is another area utilizing rock excavation similar to **X7.** Area X8 is 160 foot long with its centerline at MP 41.25. This area of rock slope excavation (at 1H:10V) is proposed to avoid takings or easements within the Perkins Farm Conservation Area, and area that also includes a MNHESP-designated Priority Habitat for Rare Species.

At the northern part of the Perkins Farm Conservation Area, a pile and lagging wall will be utilized to retain minimal amounts of soil and provide a barrier next to this ecologically sensitive area. This wall is designated **Wall S3** (Figures 14L and 14M). It is 930 feet long and its centerline is at MP 41.15. The right-of-way is only 15 feet from the third track centerline for the southernmost 500 feet of this wall. Since the wall can be no closer than 12 feet to the track centerline and since lateral loads are minimal, this vertical wall type is a good choice for this location. It is assumed that the piles will not need to be drilled into rock at this location.

For the limits of **Area X9** (see Figures 14M and 14N) within the southern portion of the Perkins Farm Conservation Area, drilled in place soldier piles with timber lagging and concrete facing walls are recommended to avoid property impacts. This wall would also avoid impacts to a trail or path that is shown along the northern portion of the property line.

Retaining Wall S4 is incorporated into the design at the southern limits of Perkins Farm Conservation Area. This wall is 520 feet long and its centerline is at MP 40.83. Refer to discussion on Wall S3 for additional information.

Area X10, north of the Sack Storage Facility, Inc., is another area where existing rock will be excavated from the footprint of the proposed third track. This area is 400-feet-long and is centered on MP 40.72 (see Figure 14O). Excavation will be at a 1H:10V slope, and some rock bolting may be required.

At **Area X11**, south of the Sack Storage Facility, Inc. (shown on Figures 14P and 14Q), it is recommended that a permanent soil nail wall be constructed. In areas like this, where soil slopes are encountered, using soil nail walls would reduce the amount of excavation that would otherwise be needed if a more conventional reinforced concrete wall was constructed.

As the alignment continues south past the ledge on the west side of the proposed third track past the Sack Storage Inc. facility, **Retaining Wall B3**, shown on Figure 14Q, is required to hold back the rising grade. The majority of this stretch of retaining wall will be located beyond the right-of-way which is in close proximity to the proposed track alignment. Temporary sheet piling will also need to be

incorporated into the design to support the face of excavation as the retaining wall is constructed. Retaining Wall B3 is approximately 210 feet long and is centered on MP 40.32 (Figure 14Q). Note that this location is also a candidate to employ a soil nailed wall. For this report, the retaining wall option is included in the cost estimate.

On the east side of the tracks, just north of Sunderland Road Bridge, **Retaining Walls A7 and B4** (shown on Figure 14Q) are used to support track loads and retain soil as they also provide a barrier to a residential area. Type A7 wall is 470 feet long and its centerline is at MP 40.30. The B4 (about 80 feet long) wall interfaces with the wingwalls of the Sunderland Bridge. Temporary sheeting will be required for this wall.

Just south of Sunderland Road (MP 40.23), the existing grade adjacent to the proposed third track drops off steeply. **Retaining Wall C3** (620 feet long) is proposed as an alternate to adding massive quantities of fill that would be required to stabilize the proposed track along this embankment. This area includes the Southwest Commons Mall. The approximate centerline of this retaining wall is at MP 40.17. Temporary sheet piling will be incorporated to support the existing tracks while an area is excavated to enable construction of the retaining wall. The walls and sheeting can be installed without infringing on the right-of-way in this area (Figures 14Q and 14R).

Retaining Wall B5 (330 feet long), located along the Camosse Masonry Supply Company north of Route 20, and **Retaining Wall C4** (940 feet long), situated alongside industrial properties south of Route 20, are the preferred method of stabilizing the proposed third track where the existing adjacent grade drops off sharply. Much like Retaining Wall C3 described above, these retaining structures eliminate the need for massive amounts of fill. The B5 wall is north of Route 20. For the majority of the length of the wall, the structure can be constructed without going beyond the right-of-way. There is a 60-foot stretch of wall that will however go beyond the right-of-way. This area is centered on MP 39.97. At portions of the Wall C4 location, it is very likely that the retaining structure will go beyond the right-of-way. In these locations the right-of-way is about ten feet from the track centerline. Since the heel of the retaining walls would approach the footprint of the existing tracks, temporary sheeting would be required to enable construction of Retaining Walls B5 and C4. The centerline of Retaining Walls B5 and C4 are approximately located at MP 39.97 and MP 39.82 respectively (Figures 14R and 14S).

Retaining Wall A8 starts approximately at the Stone Box Culvert 39.77 on the west side of the tracks. This retaining wall is used to minimize the fill sections that otherwise would extend across the right-of-way, where an existing pond (Pond 3) and Wetland E is located. This wall is 360 feet long and is approximately centered at MP 39.73. **Wall S4** would extend this wall 130 feet to avoid impacts on Wetland E, the pond, and adjoining property.

As the track extends into Millbury, **Retaining Walls B5-a, A8-a, and S5** are proposed to prevent excavation beyond the right-of-way. Wall B-5a would extend east 420 feet from approximately MP 42.61, and Wall A8-1 would extend the wall 100 feet and is centered on MP 39.52. Wall S5 would further extend the wall 85 feet to the east.

Wall S6 is proposed to both avoid property impacts and to avoid impacts to Wetland J. This wall would extend 370 feet and would be centered on approximately MP 39.34.

As the third track improvements continue into Grafton, the alignment passes through a low-lying swampy area west of the tracks. In this area, **Retaining Walls B6, A9, and B7** are located between Mileposts 39.11 and 38.90. Wall B6 (200 feet long) is approximately centered on MP 39.07. Wall A9 (500 feet long) is approximately centered on MP 39.00, and Wall B7 (320 feet long) is approximately centered on MP 38.92. These retaining walls are again considered as an alternate track support to sloping fill sections that would require a sloping easement. Wall B7 would avoid impacts to both adjoining property and Wetland N at the base of the embankment slope, and **Wall S7**, located north of the Wyman Gordon Industrial Area, would extend this wall by 383 feet to the south to avoid impacts to Wetland N and adjoining property. Existing grades are well below the proposed track system elevation in this area. If fill were added to support the proposed track, the limits of the sloping fill would go beyond the right-of-way, unless a retaining wall is utilized. Temporary sheet piling would likely be required at these retaining walls (Figure 14W).

6.9. Potential Staging Areas

The following sites are potential construction access, staging and lay down areas, which could potentially be used by a contractor.

- **Potential Staging Area 1:** A potential staging area is a privately-owned property at the defunct driving range just east of CP43 that is proposed for redevelopment. This can be accessed from the maintenance road off of Putnam Lane.

- **Potential Staging Area 2:** A potential staging area is available at the Millbury Wye MP 39.5, which is owned by CSX and can be accessed from south side of right-of-way.

- **Potential Staging Area 3:** The wye with the Grafton & Upton Railroad at MP 37.6 was formerly used in the double tracking project for ballast reclamation.

- **Potential Staging Area 4:** The Ashland Station parking lot is under-utilized. A portion of lot could be made available for contractor access and lay down.

There are also numerous locations along the line that CSX forces use for access to the track, interlockings, various bridges, and instrument houses.

6.10. Utilities Issues

A number of utilities cross under or over the tracks in both the Ashland-Framingham and the Worcester-Millbury-Grafton project segments that could be affected by the third track addition. This section addresses only the two major utility relocations that would be required to accommodate the third track addition: a high-voltage transmission system along the Worcester-Millbury-Grafton segment and the fiber-optic communication systems that extends along both project segments. As discussed earlier, research on CSX agreements is needed to determine the responsible party for the costs of these relocations. These major utility relocations are described below.

6.10.1. Impacts on High-Voltage Transmission System

The proposed track improvements in the section where the overhead transmission system runs parallel to the tracks (approximately MP 42.44 to MP 38.95) generally consists of adding a third track parallel to the existing two tracks. The impacts to the existing transmission system are discussed below.

West of Sunderland Road in Worcester (MP 40.23) the new track would be constructed south of Track 2 and would directly impact the existing high-voltage transmission system. Within that section, most of the existing 29 transmission poles are located only a few feet laterally from the centerline of the proposed third track and would have to be relocated. Several poles are located outside of the required 8'6" clear zone from the track centerline (for example at the base of a track embankment) and may not necessarily have to be relocated because of interference with railroad operations.

For a limited distance east of Sunderland Road (MP 40.23) the new track would be located on the north side of the existing double tracks and thus the proposed track work would not impact the existing poles south of the tracks. Because the new track would be constructed to the north of the existing double tracks in this area, the first six poles east of Sunderland Road would not be an obstruction to the proposed track and could potentially remain. East of those first six poles however, the proposed third track transitions back to the south side of Track 2 and the poles are again in conflict with the proposed track. Of the 16 poles east of Sunderland Road, a continuous section of six poles would not conflict with the track and could potentially remain.

Just east of the above area, at approximately MP 39.15 in Millbury, another cross-country type overhead utility transmission system crosses over the tracks. That system, including poles/supports, would not be impacted by the proposed track improvements since they are well away from the tracks.

6.10.2. Relocation Options for High-Voltage Transmission System–Option 1

This option would relocate all 45 existing poles from the south side of the existing double tracks to a location north of the tracks. While this would be the most expensive option, it appears to facilitate future access to the overhead system and have fewer potential impacts on rail operations since the utility owner may not be required to get permission to cross tracks and would have less potential to foul all tracks.

6.10.3. Relocation Options for High-Voltage Transmission System--Option 2

This option would be similar to the above, except that the first six poles east of Sunderland Road (MP 40.23) would be retained. This would reduce construction costs since only 39 of the 45 existing poles would be moved; however, this would introduce two new locations where high-voltage wires would cross directly over the tracks. This situation may have some impacts on future railroad operations since in some situations, the owner may have to access both sides of the track corridor simultaneously and/or foul tracks for a longer time. This option has been shown on the plans.

6.10.4. Fiber Optic Communication System (owned by Sprint)

The proposed track improvements are not anticipated to have major impacts to the fiber optic system. It is assumed that the existing fiber optic system can remain in place between Tracks 1 and 2 except in areas where it would be located below new track work. The depth of cover over the fiber optic system and the potential impacts due to the track work are unknown, and, hence, for purposes of this study, it is assumed that the fiber optic system should be relocated if it would be located below the track. Any handholes obstructed by the new track would also have to be relocated to maintain access. Final decisions regarding the exact limits of the fiber optic system that would have to be relocated will be made during the design process and would involve both the railroad and utility owner.

6.10.4.1. Ashland-Framingham Segment

Overall, within the Ashland-Framingham project segment, new track will be constructed over a total of approximately 3,900 feet of the fiber optic system. These impacts occur at three different locations as described below.

- In Ashland, east of Main Street, existing Track 1 will cross over to existing Track 2, resulting in new track being constructed over the fiber optic system. This will impact approximately 700 feet of the fiber optic system.
- Several thousand feet east of the above location, the fiber optic system is located south of Track 2. The exact offset from Track 2 to the fiber optic system is not known, however, it is assumed to be relatively close to the track. The proposed third track will likely be in this same location. Approximately 1,850 feet of the fiber optic system could potentially be impacted by construction.
- Further east, existing Track 2 will cross over to existing Track 1. This will involve track construction on top of fiber optic lines for a distance of approximately 1,350 feet.

An alternative to relocation would be to install a spare (empty) conduit offset from the tracks in the above listed impacted areas. This alternative would facilitate relocating fiber optic cables (pulling fiber optic cables in an empty conduit constructed as part of the track improvement project) at a later date should a problem occur within the section of fiber optic below the tracks. This would minimize future disruption in rail operations since the conduit would already be in place, ready to receive the fiber optic

system.

6.10.5. Worcester-Millbury -Grafton Segment

Overall, within the Worcester, Millbury and Grafton project area, new track will be constructed over a total of approximately 1,750 feet of the fiber optic system. These impacts occur at three different locations as described below.

- In the area of Sunderland Road, trains traveling on existing Track 2 will cross over onto existing Track 1 (which would be renumbered to Track 2), thus resulting in new track over the top of the existing fiber optic system. This will impact approximately 400 feet of the fiber optic system.
- Further toward the east, a section of the fiber optic system between approximately MP 39.73 (Worcester) and MP 39.52 (Millbury) would be similarly impacted by Track 1 crossing back over to Track 2. Approximately 1,100 feet would be potentially impacted by construction.
- At the far easterly project limit in Grafton, a proposed crossover (switching) between Track 1 and Track 2 would result in new track being constructed over approximately 250 feet of the fiber optic system.

An alternative to relocation would be to install a spare (empty) conduit offset from the tracks in the above listed impacted areas. This alternative would facilitate relocating fiber optic cables at a later date should a problem occur within the section of fiber optic below the tracks. This would minimize future disruption in rail operations since the conduit would already be in place, ready to receive the fiber optic system.

6.11. Cost Estimates

A major consideration in the development of the project was cost. The premier question was and remains – what is the best use of capital expenditure to improve CSX capacity to a level that would allow the addition of MBTA commuter trains? When making these decisions, not only initial capital costs for infrastructure improvements were considered, but also how to mitigate construction impacts on existing service for MBTA, Amtrak and CSX. Other factors considered included mitigating environmental impacts and life cycle costs for improvements that will require maintenance in the future.

To meet the project objectives of improving CSX capacity to improve commuter rail service, the initial level of improvements was based on the CSX *Worcester Service Study* (July 2003). All available data, including mapping, valuation plans, bridge and culvert lists, right-of-way information, environmental data, etc., were compiled and reviewed for completeness and use in this study.

At the early stage of the investigation, a preliminary screening was performed of the entire 23 miles of the Framingham/Worcester Line between Framingham and Worcester, and issues and areas of opportunities defined. A copy of an initial screening can be seen on Table A-1. For the detailed investigation of the proposed improvements along the 6.5 miles of track, following CSX safety training, site visits were performed, and field documentation prepared, with photodocumentation and measurements to supplement, verify, and document existing or changed conditions. During these site visits, design options were identified and considered at specific locations, and further information gathered to support the investigation of those options.

Based on the field visits, the conceptual design was prepared for the proposed track improvements, including modifications to bridges and culverts, utilities, bedrock excavation, retaining walls, and costs were developed for each of these items. The following is a brief discussion of the costing methodology used for each item. All costs were estimated using 2005 dollars.

Table 6—Construction Cost Estimates

Ashland - Framingham		Worcester - Grafton	
Track	$1,610,000	Track	$4,432,000
Signal	$1,625,000	Signal	$2,808,000
Bridges	$100,000	Bridges	$2,050,000
Culverts	$20,000	Culverts	$100,000
Walls	$544,000	Walls	$19,094,000
Civil	$250,000	Civil	$2,730,000
Drainage	$50,000	Drainage	$200,000
Utilities	$156,000	Utilities	$4,950,000
Right-of-way	$14,000	Excavation	$9,788,000
		Right-of-way	$19,700
		Mitigation	$23,000
Sub-Total	$4,369,000	Sub-Total	$46,195,000
25% contingency	$1,092,000	25% contingency	$11,549,000
8% Engineering Design	$350,000	8% Engineering Design	$3,696,000
Total	**$5,811,000**	**Total**	**$61,439,000**
Total Project		**$67,250,000**	

6.11.1. Track

Track construction costs are based on realigning track or new track construction that meet CSX standards for mainline, secondary and siding tracks as applicable. New track construction consists of all costs of labor, equipment and materials necessary to construct track consisting of new 136# rail continuously welded (CWR), resilient plates, OTM, wood cross ties, and AREMA #4 granite ballast. New turnouts and crossovers would be constructed with similar materials. plus standard CSX special trackwork components and either power or hand-thrown switches, as applicable. Track shifts would consist of upgrading the existing track to meet new standards, plus the labor and equipment to physically shift the track to its new location as well as tamping, surfacing and aligning to meet geometric requirements. The work and associated costs will also cover realigning turnouts, relocating turnouts, removing turnouts, straight railing track, removing track, and new grade crossings as necessary. Ancillary work will include modifying or adding existing features, such as curve lubricators as required.

6.11.2. Bridges, Culverts, and Retaining Walls

The basis of construction cost estimate for bridges, culverts, and retaining walls on this project was to identify the required rehabilitation, modification, or construction then compute or estimate respective quantities. To compute miscellaneous quantities, as-built drawings (if they were available), field measurements, engineering analysis, or engineering judgment (where no other means were available) were used. Once the required construction type and its respected quantities were computed, the Means Heavy Construction Cost Data 2005 and MassHighway Weighted Average Bid Prices 2002-2004 were used and adjusted for city and year to calculate the construction cost. Several factors were applied to account for level of estimate, future uncertainties, construction staging, and lack of information. In particular, a 40% premium for staged construction, and 25% overall contingency were used.

The single most costly item is for installation of retaining walls to avoid or minimize property and environmental impacts, which accounts for $19.094 million or roughly 1/3 of the total cost of the Worcester-Millbury-Grafton improvements. The costs for each of the 32 retaining wall within the Worcester-Millbury-Grafton project segment are shown in Table 7. As previously noted, a conservative approach was taken in locating walls in that walls were shown to avoid all property impacts, regardless of type or sensitivity of use. These retaining wall locations should be reviewed in subsequent design phases to determine if cost savings are possible through additional property takings.

6.11.3. Excavation and Excavation Support Cost Estimates

It is anticipated that approximately 35,000 cubic yards of bedrock will need to be excavated, assuming that a 1H:10V slope is created, with the toe of slope located 14 feet from the centerline of the proposed third track.

If expansive grout is used due to space and logistical restrictions, the cost for drilling and grouting would be roughly $45 per cubic yard, resulting in a cost of about $2.5 million.

Table 7—Costs for Worcester-Millbury-Grafton Retaining Walls

DESCRIPTION	COST
Wall A1	$123,000
Wall A2	$394,000
Wall A3	$739,000
Wall A4	$160,000
Wall A5	$160,000
Wall A5-a	$592,000
Wall A6	$345,000
Wall A7	$579,000
Wall A8	$444,000
Wall A8-a	$123,000
Wall A9	$616,000
Wall B1	$271,000
Wall B2	$459,000
Wall B3	$438,000
Wall B4	$167,000
Wall B5	$689,000
Wall B5-a	$877,000
Wall B6	$417,000
Wall B7	$668,000
Wall C1	$916,000
Wall C2	$382,000
Wall C3	$2,367,000
Wall C4	$3,665,000
Wall S1	$918,000
Wall S1-a	$96,000
Wall S1-b	$540,000
Wall S2	$235,000
Wall S3	$919,000
Wall S4	$346,000
Wall S5	$45,000
Wall S6	$197,000
Wall S7	$204,000
TOTAL	**$19,094,000**

The cost to excavate and haul the excavated rock would likely be about $30 per cubic yard , resulting in a cost of about $1.5 million. Normal drilling and blasting outside sensitive areas is estimated to total $4 million.

It is estimated that about 20% of the entire length of the rock face, or about 600 linear feet, would require rock bolting, with some rock netting also required due to highly fractured zones of rock. The estimated cost for rock bolting and netting is about $150,000.

The estimated cost for a permanent soil nail wall would be about $60 per square foot, for a total project cost of $1.638 million. The total costs for excavation and excavation support are estimated to be approximately $9.788 million.

6.11.4. Utilities

Costs to relocate and/or protect major utilities running longitudinally within the right-of-way, namely the high-voltage transmission system in the Worcester-Millbury-Grafton area and the fiber-optic communication system in both project segments, were estimated based on the type of work involved and representative unit costs. The responsible party for these costs needs to be ascertained, based on research of CSX utility agreements.

6.11.4.1. High-Voltage Transmission System

Unit costs for relocating the high-voltage transmission system in the Worcester-Millbury-Grafton project segment were based on information provided by National Grid (the utility owner) including an order of magnitude cost per mile to relocate this type of system. That estimate was adjusted to account for site access limitations, site conditions, engineering judgement, and expertise of staff involved with this type of work. Based on the above, a unit cost of $125,000 per pole relocation was considered to be representative for this project.

The estimated costs associated with the two options for relocating the high-voltage system are:

- **Option 1:** This option involves relocating all 45 existing poles from the south side of the tracks to the north side. Although some of the existing 45 poles (including a continuous run of six poles east of Sunderland Road) would not be impacted by the proposed track work, the advantage of this relocation option is that all the high-voltage poles would be on one side of the tracks, and thus the overhead cable would never cross over the three mainline tracks. This would facilitate future operations/maintenance by the utility owner and minimize the potential for disruption of rail operations due to work on the utility. The cost of this option would be approximately $5.63 million.
- **Option 2:** This option would relocate 39 of the existing 45 poles to the north side and would retain an existing continuous run of six poles east of Sunderland Road, which are not impacted by track construction and could otherwise remain in place. This option would add two additional crossings of the high-voltage cables over the tracks. Two crossings already exist. Option 2 would involve lower construction costs that Option 1 above, but has the disadvantage of increasing the number of crossings of high-voltage cables over the tracks. This could potentially impact future operation and maintenance of the utility and increase the potential for disruption of rail operations during certain work on the utility (such as a downed cable). The cost of this option would be approximately $4.88 million. This cost is assumed in Table 6, as part of the total construction cost estimate.

6.11.4.2. Fiber Optic Communication System

Ashland-Framingham Segment

The existing underground fiber optic system will be located below proposed tracks at several locations. Two options have been identified for maintaining and protecting the fiber optic system. These options and the approximate costs are:

- **Option 1:** Option 1 assumes the fiber optic would be relocated so that it would not be below the tracks. This would be required if the existing fiber optic system is not buried deep enough and could be impacted by future track maintenance activities. The depth and number/type of fiber optic transmission cables are not known at this time. Accordingly, the relocation cost per foot is based on an assumed cost of $40 per linear foot of relocation, complete in place (conduit, fiber optic cables, encasement, trenching, backfill, handholes, splicing, etc.)

  Based on approximately 3,900 feet of the fiber optic system being impacted, the estimated cost would be $156,000. This cost is assumed in Table 6, as part of the total construction cost estimate.
- **Option 2:** Option 2 assumes the existing fiber optic system remains in place, as-is, and a new empty duct is installed should the fiber optic cables themselves ever need replacement. This option assumes the existing fiber optic system is buried deep enough that it would not be impacted by track construction and can remain below the proposed track. This option precludes the need to undertake construction in the future (such as trenching, laying conduit, backfilling) which could disrupt rail operations. The cost of this option (which would include all the costs in Option 1 except providing & installing the actual fiber optic cables) is estimated to be approximately $30 per linear foot.

  Based on approximately 3,900 feet of the fiber optic system being impacted, the estimated cost would be $117,000.

Worcester-Millbury-Grafton Segment

The existing underground fiber optic system will be located below proposed tracks at several locations. Two options have been identified for maintaining and protecting the fiber optic system. These options and the approximate costs are:

- **Option 1:** Option 1 assumes the fiber optic would be relocated so that it would not be below the tracks. This would be required if the existing fiber optic system is not buried deeply enough and

could be impacted by future track maintenance activities. The depth and number/type of fiber optic transmission cables are not known at this time. Accordingly, the relocation cost per foot is based on an assumed cost of $40 per linear foot for complete, in-place relocation, (conduit, fiber optic cables, encasement, trenching, backfill, handholes, splicing, etc.).

Based on approximately 1,750 feet of the fiber optic system being impacted, the estimated cost would be $70,000. This cost is assumed in Table 6, as part of the total construction cost estimate.

- **Option 2:** Option 2 assumes the existing fiber optic system remains in place, as-is, and a new empty duct is installed should the fiber optic cables themselves ever need replacement. This option assumes the existing fiber optic system is buried deep enough that it would not be impacted by track construction and can remain below the proposed track. This option precludes the need to undertake construction in the future (such as trenching, laying conduit, backfilling), which could disrupt rail operations. The cost of this option (which would include all the costs in Option 1 except providing and installing the actual fiber optic cables) is estimated to be approximately $30 per linear foot.

  Based on approximately 1,750 feet of the fiber optic system being impacted, the estimated cost would be $53,000.

6.11.5. Property Acquisitions

For cost estimating purposes, the 2005 assessed value of 10 properties (land only) were compiled along the right-of-way in Worcester, calculated the assessed value per square foot, and determined the average value per square foot of the 10 properties. This calculated estimated value is $3.40 per square foot.

It is estimated that approximately 9,910 square feet of property (approximately 4,110 square feet in Ashland and approximately 5,800 square feet in Worcester) will need to be acquired for the project. This has an estimated value of $33,700, with $14,000 in Ashland and $19,700 in Worcester.

7. Environmental Impacts

7.1. Traffic

Installation of the third track will increase the number of commuter rail trains operating between Framingham and Worcester. This traffic could increase by as little as four trains (two round trips) daily, depending on the outcome of negotiations between the MBTA and CSX. The only grade crossings between Framingham and Worcester that would be affected by this additional traffic are located at Cherry Street and Main Street in Ashland. Other grade crossings inbound, or east of the project, including the Route 126 grade crossing in Framingham, would continue to experience the same number of commuter train crossings. Currently, 20 commuter rail trains a day continue past Framingham to Worcester, and the other 20 trains servicing Framingham Station turn back at the station to return to Boston. If a portion of the trains that currently turn back at Framingham Station would continue on to Worcester, there would be no appreciable increase of train traffic at the Route 126 grade crossing or other grade crossings inbound from Framingham Station.

Direct impacts from the track improvements at the Ashland Main Street grade crossing and at bridges to be reconstructed in Worcester are discussed below.

7.1.1. Ashland-Framingham Segment

The only location where construction may affect roadway vehicular traffic is at the Main Street grade crossing in downtown Ashland, which would be affected under Option 2 for tying in west of Main Street. Option 1, the preferred option, would tie in east of Main Street and would not involve an additional grade crossing. Installation of the proposed third track at the at-grade crossing at Main Street should be performed during a weekend when traffic volumes are less; thereby, minimizing disruption to adjacent businesses and pass-by traffic. For these short periods of time, Main Street vehicular traffic may be detoured via Front Street, Fountain Street, and Union Street. It is anticipated that this work would be of short duration, and no substantial traffic impacts should occur as a result of project construction.

7.1.2. Worcester-Millbury -Grafton Segment

The only two bridges that will be reconstructed, resulting in traffic detouring, are at the Hamilton Street Bridge and at the Sunderland Road Bridge.

7.1.2.1. Hamilton Street

In order to accommodate the proposed third track, the westerly abutment and superstructure of the Hamilton Street Bridge will be removed and replaced with new structures. Because fairly significant traffic volumes exist along Hamilton Street and the roadway serves as a bus route, the current operation of one lane of traffic for each direction should be maintained during construction. Review of the existing bridge type indicates that one lane of vehicular traffic for each direction and pedestrian traffic can be maintained by staged construction to replace the westerly abutment and superstructure. A conceptual traffic maintenance plan for each stage is shown in Figure 16a. Since the present traffic operation (one lane in each direction) will be maintained during the two-year construction period, no substantial traffic disruptions will occur as a result of construction.

7.1.2.2. Sunderland Road

In order to accommodate the proposed third track, the existing Sunderland Road Bridge will be widened to the easterly side. It is anticipated that the newly widened portion will maintain the same arch shape as the existing structure. Due to the existing substandard vertical clearances over Sunderland Road and a significant traffic volume along Sunderland Road, staged construction should be employed to provide similar vertical clearance and to maintain one lane of vehicular traffic for each direction and pedestrian traffic during construction. Because sight distances are limited along Sunderland Road in the vicinity of the bridge due to the downgrade slope and the horizontal curve, a sufficient number of signs should be

posted to alert motorists for construction activities at the bridge. A conceptual traffic maintenance plan for each stage is shown in Figure 16b. Since the present traffic operation of one lane in each direction will be maintained, there will be no substantial traffic impacts at this location during the two-year construction season.

7.1.3. Construction Staging Areas

Construction staging areas will be determined by the contractor, and potential staging areas are identified in Section 6.9. The contractor shall coordinate with and obtain approvals from applicable municipalities for locations of and access from/to the construction staging areas. The staging areas shall be located such that there will be no impacts to adjacent vehicular and pedestrian traffic.

7.2. Land Use and Zoning

7.2.1. Land Uses along the Ashland-Framingham Segment

The majority of the proposed track construction will occur within the right-of-way. The proposed track will extend along and past the property line for a parking area for the Ashland Technology Center on Homer Avenue. This will require right-of-way acquisitions, which will affect approximately 4,110 square feet within the parking lot property. The affected land includes greenery that buffers this lot from the railroad and extends past the fence around the parking lot, affecting a small strip past the fenceline. The parking lot itself would largely be unaffected, although the taking of the strip behind the fence may affect the capacity of the lot. Under proposed Option 1 for the Main Street grade crossing, there should be no direct property impacts on the parcel on Front Street, north of the tracks, that was acquired for redevelopment by the Ashland Redevelopment Authority.

In addition, Option 2, which extends the third track across Main Street, would affect properties on the north side of the railroad, on both sides of Main Street. A portion of the back of the Ashland Police and Fire Station property, totaling roughly 1,350 square feet, would be affected. This portion of the property adjoins the railroad and is in back of the parking lot behind the facility. Approximately 640 square feet of the property that closely adjoins the track on the west side of Main Street would also be affected by Option 2. The affected property includes an ATM machine for Banknorth and Lunker's Bait and Tackle Shop fronting on Main Street, and Mehitable's Bakery in the back of the property. This property taking would extend close to the back corner of the building, where there are several doorways that adjoin the railroad right-of-way on this side of the building. On the east side of Main Street, the third track addition would result in acquisition of a total of roughly 1,340 square feet of property within the town square. This includes roughly 20 square feet of the parcel that includes the Ashland World War Monument and this right-of-way taking would affect a corner of the sidewalk. The remainder of affected property fronts on, but does not extend into, a parking lot for the municipal square.

Option 2 would affect an additional a total of approximately 3,330 square feet, including municipal property. Option 2 is not recommended for further consideration, and Option 1, which would connect east of Main Street is proposed.

Property impacts in this project segment, under the preferred option (Option 1, which terminates east of Main Street) would be confined to the strip taking (approximately 4,110 square feet) adjoining the Ashland Technology Center parking lot. This taking should have a minimal impact on the parking at this location, given that the majority of affected land is outside of the fenceline for the parking lot.

7.2.2. Land Uses along the Worcester-Millbury-Grafton Segment

7.2.2.1. Industrial/Commercial/Residential Areas

The majority of property impacts are proposed to be avoided through the use of retaining walls. A few properties will be affected by the proposed installation of retaining walls. These include:

- **Milepost 43:** Approximately 220 square feet of undeveloped ledge on a slope west of Tampa Street would be bisected and affected by a continuous retaining wall in an area of steep ledge (Retaining Wall A1 and B1).
- **Milepost 40.37-40.28:** Approximately 3,890 square feet within the Sack Storage Facility, Inc. property will be affected by ledge excavation at Area X11.
- **Milepost 39.95:** Approximately 70 square feet within the Camosse Masonry Supply Company will be affected by Retaining Wall B5 north of Route 20.
- **Milepost 39.92-39.84:** Approximately 1,620 square feet within the industrial complex south of Route 20, on the Southwest Cutoff, would be affected by Retaining Wall C4.

A total of approximately 5,800 square feet would be affected by the proposed retaining wall construction. Most of the properties affected are industrial in nature. These takings consist of underutilized strips adjoining the railroad that currently buffer the adjoining land uses from the railroads. The proposed retaining walls would create a preferable buffer between the railroad and the adjoining land uses. No impacts to land uses on these properties would occur as a result of these takings.

A number of retaining walls extend along the property lines, and installation of these walls may require temporary easements.

7.2.2.2. Community Facilities and Parks/Recreation Areas

Impacts on publicly owned parks, such as Perkins Farm Conservation Area, North High School, and the Ecotarium, will be avoided through the use of retaining walls. However, the proposed work may affect approximately 120 feet of a trail that is mapped as extending within the railroad right-of-way. In addition, installation of these walls may require a temporary easement. For installation of these walls,

acquisition of a temporary easement may be needed for installation of a retaining wall, but no substantial impacts on these properties are anticipated, as the duration of this construction would be short-term.

7.3. Environmental Justice

DOT Order 5610.2 states that Environmental Justice is comprised of three fundamental principles in transportation planning:

- to avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations;
- to ensure the full and fair participation by all potentially affected communities in the transportation decision-making process; and
- to prevent the denial of, reduction in, or significantly delay of the receipt of benefits by minority and low-income populations.

The only area where an environmental justice population was identified was on the northwestern end of the Worcester-Millbury-Grafton segment. Both sides of the track adjoin environmental justice populations extending ½ mile east to Plantation Street. The south side of the tracks adjoining Tampa Street and Plantation Street in this area include housing, but the majority of the remaining area adjoining the site of the track improvements are either undeveloped or industrial in nature. Steep rock slopes are proposed adjoining Tampa Street and Plantation Street to avoid property impacts, and no substantial residential takings or displacements would occur. The remaining ½ mile of track that adjoins environmental justice populations is located predominantly north of the tracks, on the opposite side of the tracks from the proposed third track additions.

7.4. Noise and Vibration

7.4.1. Effects of New Rail Line Location

The relocation of new mainline tracks by 12 to 15 feet will generally not, by itself, result in a significant change in train related noise levels. A preliminary analysis showed that adding a third mainline track and moving 50% of rail traffic to the new track location would increase noise levels by approximately 0.4 dBA at a receiver location 100 feet from the original track location. At this point in the project it is not known precisely how each mainline track will be used in future operation. Therefore it was assumed in our analysis that the acoustic center of the 3-mainline track corridor would move approximately six feet toward the direction of the new track. For example, if a home were located approximately 100 feet from the center of an existing two track corridor and a third Main Line track were added between the existing tracks and the home, the new effective distance would be 94 feet from the home to the acoustic center of the corridor. Similarly, for homes on the opposite side of the new mainline track it is assumed that the new acoustic center would be slightly more distant.

7.4.2. Impact Criteria

Noise and vibration impacts for this project were assessed according to prediction procedures and impact criteria established in the Federal Transit Administration manual for Transit Noise and Vibration Impact Assessment (Final Report Number DOT-T-95-16, 1995).

7.4.2.1. Noise Impact Criteria

For noise impacts, the FTA impact criteria are defined as the relative difference between existing noise levels and new project related noise levels. In these established criteria, those noise sensitive land uses with higher existing noise levels are assigned smaller relative increases in project related noise level before triggering an impact. Table 8 below summarizes the FTA impact criteria for noise.

Table 8—FTA Noise Impact Criteria: Effect on Cumulative Noise Exposure

Ldn or Leq in dBA (rounded to nearest whole decibel)			
Existing Noise Exposure	Allowable Project Noise Exposure	Allowable Combined Noise Exposure	Allowable Noise Exposure Increase
45	51	52	7
50	53	55	5
55	55	58	3
60	57	62	2
65	60	66	1
70	64	71	1
75	65	75	0

Source: FTA Transit Noise and Vibration Impact Assessment, Table 3-3

For residential land uses, the 24-hour Day-Night Noise Level metric (Ldn) is used for impact assessment. This metric represents the 24-hour equivalent noise level with a 10 decibel penalty for noise during nighttime hours (10 PM to 7 AM).

7.4.2.2. Vibration Impact Criteria

FTA vibration impacts are based upon projected absolute vibration levels for proposed projects. For residential land uses, the vibration impact criterion is 80 VdB (re 1 micro-inch/sec) for infrequent events (less than 70 vibration events per day).

7.4.3. Future Conditions

7.4.3.1. Future Noise Levels

Future noise levels were predicted for identified sensitive receiver locations near the Framingham/Worcester line tracks in the areas where the new third line is proposed. The predictions were made in a manner consistent with FTA noise impact assessment guidelines and are based upon the following future anticipated rail operation.

Table 9—Noise Prediction Assumptions: Proposed Future Rail Service on Worcester Commuter Rail Line	
Noise Source	**Assumed Source Characteristics**
Freight Rail	16 trains/day, 12 trains/night, 2 locomotives + 34 cars/train, 50 mph
Amtrak Rail	3 trains/day, 1 train/night, 1 locomotive + 6 cars/train, 60 mph
MBTA Rail	37 trains/day, 4 trains/night, 1 locomotive + 7 cars/train, 60 mph

Predicted noise levels for identified receivers in this area ranged from 63 to 72 dBA Ldn. Along with the assumption that both current and future noise levels are dominated by train noise this would result in a relative increase of approximately 1 to 2 dBA, Ldn.

7.4.3.2. Future Vibration Levels

No vibration measurements were made as part of this analysis. However, general vibration assessment guidelines from the FTA manual for Noise and Vibration Impact Assessment suggest that vibration levels in this area may be in the range of approximately 71 to 88 VdB, with impacts triggered at a distance of approximately 80 feet from the nearest mainline track. These predicted levels are only approximate, and would need to be further refined if this project were to be advanced to preliminary design, with more detailed knowledge regarding soil conditions and rail design parameters (such as precise locations of switches, rail ballast, tie and fastener designs).

7.4.4. Predicted Impacts

7.4.4.1. Potential Noise Impacts

With an existing noise level of 65 dBA, project noise in excess of 61 dBA would constitute an impact. Our analysis indicates that sensitive receiver locations within approximately 100 feet of the track corridor centerline would expect to see project noise levels of 61 dBA or greater. The analysis shows that 31 of the 122 identified receptors (28 residences and three commercial properties) would meet or exceed the noise impact threshold as indicated in the accompanying spreadsheet table. Of these impacted receptors, 13 receptors are located in Ashland, and 18 receptors are located in Worcester. These include two commercial properties in Worcester, and one in Ashland, for a total of 12 affected residential receptors in Ashland and 16 in Worcester.

No severe impacts were identified. Of the 31 properties exceeding the impact threshold, only one of those (property in Ashland) exceed the threshold by 1.0 dBA or more, and none by more than 2.0 dBA.

7.4.4.2. Potential Vibration Impacts

FTA vibration criteria identify 80 VdB as the impact threshold for residential land uses for infrequent rail events. According to our analysis this level would be experienced at a distance of approximately 80 feet from the proposed track centerline for assumed conditions. Our site analysis indicates that as many as 15 residential properties meet or exceed the vibration impact threshold. Of these, six receptors (one commercial property and five residential properties) are located in Ashland, and nine receptors (two commercial property and eight residential properties) are located in Worcester.

7.4.5. Impact Abatement Options

7.4.5.1. Noise Impact Abatement Options

The primary option for rail noise abatement is a noise barrier such as a structural wall or earth berm. However, this type of abatement option is generally required to meet cost-effectiveness requirements. Noise walls are usually cost-effective only when several impacted properties are located close together and can be protected by a single continuous barrier. An alternative noise abatement option that is sometimes used when noise barriers are not feasible is residential sound insulation treatments, where architectural elements (such as doors and windows) are upgraded with acoustically superior replacements that can help reduce interior noise levels.

The MBTA has used a policy on previous projects of establishing a mitigation allowance based upon how much an impact criterion has been exceeded, typically on the order of $5,000 per decibel over the impact threshold. Because nearly all the impacts identified here exceed the threshold by only a small amount (generally less than 1.0 dBA, and none greater than 2.0 dBA), it would appear unlikely that any type of noise mitigation would be considered cost-effective by the MBTA policy (with the possible exception of some minor sound insulation treatments for a few of the most significantly impacted properties.)

7.4.5.2. Vibration Impact Abatement Options

Vibration impact abatement may include ballast mats, resilient tie supports or fasteners, and special track switches. The performance of these vibration abatement treatments can be highly dependent on soil types and special track work requirements.

The same MBTA cost-effective policy used for noise impacts has been applied for vibration mitigation. Ballast mats tend to be very expensive to install and may have trouble meeting cost reasonableness requirements. However, special vibration mitigating track systems, such as resilient tie fasteners could

be employed in areas near impacted structures to reduce or eliminate vibration impacts.

7.5. Water Resources

7.5.1. Water Resources along the Ashland-Framingham Segment

Work proposed within the Ashland-Framingham segment includes modifications at the Sudbury River Bridge and the Framingham Reservoir No. 2 Bridge in Ashland. The work within the waterway will be restricted to replacement of wingwalls at the Framingham Reservoir No. 2 bridge. This work will be constructed within the footprint of the existing wingwalls and will involve driving sheeting into the waterway. The sheeting will allow the concrete to be emplaced for the wingwalls, but will also prevent siltation from occurring within the waterway. It is anticipated that the area of the reservoir bottom that will be temporarily disturbed will total approximately 100 square feet on each side of the waterway, for a total of approximately 200 square feet or reservoir bottom affected. No permanent increase in the fill on the reservoir bottom would occur.

In addition, a 250-foot long retaining wall will be installed in Framingham along Framingham Reservoir No. 2 to minimize incursions into the reservoir embankment. The water elevation in Framingham Reservoir No. 2 is controlled by the dam spillway elevation downstream, which is set at elevation 170.22 NGVD (1929). This work may temporarily affect approximately 160 feet of linear bank along Framingham Reservoir No. 2, but the wall will be permanently installed approximately 4 feet or more above the permanent water elevation.

Sheet piling will be installed to minimize the incursion into the reservoir. Affected areas of bank will be restored, and no permanent bank impacts are anticipated as a result of this work. Other options to be considered in this location include realignment of the tracks to avoid work in proximity to the reservoir.

Installation of the bridge wingwalls in Framingham Reservoir No. 2 and the retaining wall is shown as occurring within the right-of-way. The Massachusetts Department of Recreation and Conservation (MDCR), Division of Water Supply Protection has jurisdiction over Framingham Reservoir No. 2 and surrounding property. Coordination with MDCR will be performed regarding work in or adjacent to the reservoir, and a MDCR permit may be required.

No culvert extensions are required, so there should be no impact to smaller drainages that cross the tracks.

A Stormwater Pollution Prevention Plan will be prepared, outlining appropriate erosion and sedimentation controls to be employed during construction, in accordance with the National Pollutant Discharge Elimination System Construction Stormwater General Permit.

7.5.2. Water Resources along the Worcester-Millbury-Grafton Segment

No direct impacts on the three ponds along the project area would occur. Retaining walls would be constructed to avoid impacts to the closest pond (Pond 3) south of Route 20 in Worcester. It is anticipated that culverts will need to be extended to accommodate the track addition at all fourteen culvert locations, which would affect the drainages carried by the culverts. Use of appropriate erosion and sedimentation controls, in accordance with the Stormwater Pollution Prevention Plan, would minimize impacts to adjoining waterbodies during construction.

7.6. Floodplains

7.6.1. Floodplains along the Ashland-Framingham Segment

Work performed at the Sudbury River Bridge and at the Framingham Reservoir No. 2 Bridge will occur within areas mapped as 100-year floodplain. This work will not substantially change the grades at these crossings, since the tracks would be located on the existing bridge structures, and no changes to the 100-year flood elevation would occur as a result of this work.

Installation of the retaining wall along the embankment of Framingham Reservoir No. 2 is proposed to reduce impacts to the areas adjoining the reservoir. This wall will largely be installed at or above elevation 175 feet NGVD (1929), which is the elevation of the 100-year floodplain. Therefore, no impacts on the floodplain are anticipated as a result of this wall installation.

7.6.2. Floodplains along the Worcester-Millbury-Grafton Segment

There are no floodplains along the Worcester-Millbury-Grafton segment, so no impacts on floodplains would occur on this project segment.

7.7. Wetlands

7.7.1. Wetlands along the Ashland-Framingham Segment

As discussed under Section 7.5, bridge modifications proposed at the Framingham Reservoir No. 2 Bridges would temporarily affect approximately 200 square feet of land under water. This work could also temporarily affect a total of roughly 20 linear feet of bank on each side, for a total of 40 linear feet affected. This work will also affect areas within the 200-foot riverfront protection area and the 100-foot buffer zone.

Installation of the retaining wall along the Framingham Reservoir No. 2 will involve work within the 200-foot riverfront protection area and the 100-foot buffer zone. Permanent impacts on bank are not anticipated, but temporary impacts to approximately 160 linear feet of bank may occur as a result of this wall installation. Other options to be considered in this project segment include realignment of the tracks to avoid work in proximity to the reservoir.

No permanent alterations are anticipated along the Ashland-Framingham segment. A Notice of Intent will be filed with the Framingham and Ashland Conservation Commissions addressing the work within wetland resource areas, in accordance with the Massachusetts Wetlands Protection Act. Coordination with the MDCR will be performed regarding work adjacent to Framingham Reservoir No. 2 and the need for a MDCR permit application.

7.7.2. Wetlands along the Worcester-Millbury-Grafton Segment

Installation of tracks and retaining walls will involve permanent alteration at three wetland areas. In the area west of, and on the opposite side of the tracks from, Lake Park in Worcester , Wetland C extends to the western edge of the existing track. Track installation in this area would affect approximately 4,500 square feet of bordering vegetated wetlands within Wetland C (Figure 14K). A retaining wall in this location would not minimize wetland impacts, due to the location within the right-of-way.

South of this area, the proposed installation of Retaining Wall B2 would minimize wetland fill and property impacts, but would permanently affect approximately 200 square feet of bordering vegetated wetlands. This wall installation will temporarily affect approximately 315 feet of Wetland C, but these wetlands would be restored upon completion of construction.

A total of approximately 4,700 square feet of Wetland C would be permanently altered by the track improvements and retaining wall installation. This will not exceed the performance standard under the Massachusetts Wetlands Protection Act of 5,000 square feet of bordering vegetated wetland impact.

Wetland K, which consists of three small isolated areas, would be affected by track improvements in Millbury, near the former wye track location (Figure 14V). This would affect approximately 300 square feet of isolated vegetated wetlands, which are not located adjacent to a stream and therefore are not classified as bordering vegetated wetlands under the Massachusetts Wetlands Protection Act.

It is anticipated that the project will also involve culvert extensions at all fourteen locations, which could also involve impacts to protected resource areas. The project will also require alteration of areas within the 100-foot buffer zone in Worcester, Millbury, and Grafton.

To mitigate impacts, it is assumed that wetlands replication is proposed at a minimum ratio of 1:1. Replication areas will be created adjacent to existing wetlands. To the extent practicable, the replication areas would be created adjacent to affected areas.

In accordance with the Massachusetts Wetlands Protection Act, this work will be reviewed through Notices of Intent filed with the local conservation commissions. Best management practices to be implemented during construction will include use of sedimentation and erosion controls for work performed upgradient of wetland areas.

7.8. Threatened or Endangered Species/Protected Habitats

7.8.1. Protected Habitats along the Ashland-Framingham Segment

The project segment will require bridgework within an MNHESP-designated Priority Habitat 815 and Estimated Habitat 7330, which provides habitat for the Triangle Floater (*Alasmidonta undulata*), a mussel species of special concern. Work proposed at the Sudbury River Bridge in Ashland involves construction of two-foot high headwalls at the ends of the culvert and track construction across the existing bridge. No work will occur within the Sudbury River.

Coordination with the MNHESP will be performed regarding the proposed work and the need for a permit under the Massachusetts Endangered Species Act.

7.8.2. Protected Habitats along the Worcester-Millbury-Grafton Segment

The project segment will require work within Priority Habitat 828 designated by MNHESP, which corresponds closely to the location of the Perkins Farm Conservation Area. Correspondence received from MNHESP on July 21, 2004 indicated that the orange sallow moth (*Rhodoecia aurantiago*), a state-threatened species, occurs in the vicinity of the site. Retaining walls are proposed to avoid impacts to this property and sensitive ecological habitat. Coordination with the MNHESP will be performed regarding the proposed work and the need for a permit under the Massachusetts Endangered Species Act.

7.9. Cultural Resources

As discussed in Section 5.15, no sites that are currently listed on the National or State Register of Historic Places were identified within 300 feet of the project. The *Final Environmental Impact Report for the Worcester Commuter Rail Extension Project* included an architectural survey and intensive archaeological surveys along the project.

This prior survey work included completing historic survey forms for railroad bridges along the project. Modifications are proposed to undergrade and overhead railroad bridges.

Archaeological testing that was performed in Worcester and Grafton indicated that construction of the Boston & Worcester Rail Line (now known as the Boston & Albany Line) in the 1830s impacted the entire rail corridor within the confines of MP 40 and MP33. This testing revealed that construction of the railroad and associated structures created extensive disturbance in the railroad corridor. Because no prehistoric materials were found, the historic materials recovered from the modern period, and every subsegment was found to be disturbed, no additional testing was recommended.

The Massachusetts Historical Commission has been consulted regarding the proposed work. A Project Notification has been filed for review and comment by MHC pursuant to M.G.L., Chapter 9, Section 26-27c, as amended by Chapter 254 of the Acts of 1988 (950 CMR 71.00). In correspondence dated May 10,

2006, the MHC indicated that the definition of an Area of Potential Effect and archaeologically sensitive areas would be determined when feasible project alternatives and construction impact areas are more precisely identified. The MHC did not recommend that an archaeological survey be conducted at this early stage of project planning.

The MHC suggested that the Area of Potential Effect (APE) for cultural resources be defined as at least 250 feet on either side of the center line of the right-of-way and should extend to include all listed historic districts that the right-of-way is adjacent to or within. The MHC suggested that staging areas and additional ancillary facilities be factored in when determining the APE as design plans are developed.

Coordination will continue with MHC regarding potential effects on cultural and archaeological resources as design plans are further developed.

7.10. Oil and Hazardous Materials Management

7.10.1. Approach to and Requirements for Hazardous Materials Management

In general, issues related to management of hazardous materials may include the following:

- Liability acquired through land takings associated with the project
- Worker health and safety issues associated with exposure to oil and hazardous materials (OHM) during construction
- Public health and safety issues associated with mobilization of OHM during construction
- Reuse or disposal of excess materials generated during construction

The first of these issues involves pre-construction management issues relative to right-of-way takings, and will require decisions regarding the level of effort needed to properly assess potential takings and the use of such information during the appraisal process. The next two issues will involve requirements for general Health and Safety Plans developed by any contractors working of the construction project, as well as potential regulatory requirements, and should be addressed in some fashion in final bid documents. Should environmental investigations within the corridor be conducted prior to development of bid documents, information developed during those investigations should be incorporated into the bid documents to inform bidders of relevant environmental conditions. The remainder of this section will be devoted to a general discussion of management of regulated materials during the construction process.

7.10.2. Soil Management

In areas where soils are excavated or graded prior to construction, plans must be in place to handle soils in a manner consistent with applicable regulations and policies. This is especially true in areas of the project that are net cut segments. In those net cut areas, options for soils handling are as follows:

- **Stockpile soils on-site for testing and disposal:** Under this option, all excavated soils must be stockpiled on site to be tested for waste disposal characterization profiling and subsequent removal for disposal. This option requires:
    - Sufficient space for staging stockpiles,
    - Maintenance of site security around stockpiles while waiting for laboratory results,
    - Developing safeguards to prevent surface runoff and fugitive dust emissions from stockpile,
    - Management of logistics during final loading process.

  The advantage of this option is greater certainty that soils have been characterized properly for appropriate disposal, and fewer constraints on construction sequencing that is keyed to a pre-construction field program.
- **Pre-characterize prior to construction:** Under this option, all soils are loaded directly into trucks for immediate disposal off site. It requires full pre-construction characterization of the soils such that full disposal profiles can be generated based on soil samples collected during preliminary testing rounds. The obvious advantage is the elimination of the need to generate stockpiles in areas with limited space. The main disadvantages include the need to key construction sequencing to the preliminary field program testing locations, and the fact that there is greater uncertainty in the results of the waste profile development.
- **Re-use of Soils on other parts of the Site:** This option calls for the transfer of soils from a net cut area to a net fill area of the construction corridor. It requires pre-characterization of the cut area and the receiving area, as well as state and local approval processes, particularly if the re-used material is regulated under the Massachusetts Contingency Plan (MCP).

All material intended to be transported off-site will be loaded into properly licensed and permitted vehicles and transported directly to the selected disposal or recycling facility. Similarly, for materials intended for reuse within other portions of the project, materials will be loaded into properly licensed and permitted vehicles and transported directly to the receiving area. At a minimum, truck bodies will be structurally sound with sealed tailgates, trucks will be lined in accordance with applicable regulations, and loads intended for off-site disposal will be covered with a liner, which will be placed to form a continuous waterproof tarpaulin to protect the load from wind and rain.

Decontamination stations for personnel and equipment, including vehicles, will be installed where warranted in and throughout the construction excavation areas. Determination of the need for decontamination stations will be based on a review of site-specific data in the context of applicable hazardous materials regulations, including the Massachusetts Contingency Plan (MCP). Decontamination areas will, at a minimum, be bermed and plastic-lined, and an adequate supply of decontamination equipment and water will be maintained. Wash water and sediments generated during decontamination activities will be handled in accordance with MCP Response Action Performance Standards (RAPS), where applicable.

In areas requiring construction of runoff and erosion controls, appropriate construction materials, which may include silt fencing, hay bales, erosion control matting, and chain link fence, will be available on-site and will be installed as needed. Access to areas where construction in contaminated soils is being conducted will be restricted to minimize unauthorized entry, and such areas will be visibly marked with appropriate signs warning of potential hazards.

Materials management will be performed in a manner that inhibits release of dust and vapors. Dust suppression will be performed in the warm weather months by using water to spray down areas where dust may be generated during soil movement activities. Real-time air monitoring/screening for total dust and volatile organic compounds (VOCs) will be done where warranted during work in potentially contaminated areas and whenever contaminated soil is encountered. Total dust monitoring will be conducted using a Miniram dust monitor, or equivalent. Monitoring for VOCs will be conducted using a photoionization detector (PID) or equivalent. Real-time on-site limits will be established based upon site contaminants of concern. If contamination is detected in a work area through air screening, air monitoring of the contaminants will be performed using direct reading portable analyzers and/or detectors or appropriate surrogate measuring devices and time-weighted average air sampling techniques. Additionally, monitoring for lower explosion limit, oxygen, carbon monoxide, and hydrogen sulfide will be done with a four-gas meter, as deemed necessary for the work.

Manifests, bills of lading, weight slips, material shipping records (MSR) or other shipping or handling documents will be prepared and signed by a Licensed Site Professional (LSP) prior to removal of contaminated soil from the work area. The LSP will prepare and submit all documents required by the MCP and other applicable federal, state, or local regulations relative to the transport and disposal of regulated materials.

7.10.3. Asbestos Containing Materials

Asbestos-containing materials may be encountered during the improvement project. The ages of the buildings within the corridor vary in age. Asbestos containing products have been in use in the U.S. since the early 1900's.

Building demolition is not anticipated to be required at this time. If building demolition is required, in order to make the proposed improvements, a comprehensive asbestos survey by a certified asbestos inspector will be required in accordance with the National Emission Standards for Hazardous Air Pollutants (NESHAP, 40 CFR 61). Identified asbestos must be removed by licensed contractors and disposed of at approved landfills prior to demolition.

Asbestos may also be found underground in fill materials, buried steam pipes, and in asbestos/cement pipes. Asbestos materials may be buried in locations where buildings were historically demolished and the debris was used to backfill the cellar hole. In cases where bulk asbestos containing materials can be identified during excavation, these materials should be managed properly under applicable regulations and disposed of in approved landfills. The MA DEP is currently reviewing the regulation of asbestos in soils under the MCP, and it is anticipated that a policy and regulations addressing this topic will be issued in the future.

7.10.4. Management of Contaminated Groundwater

Groundwater may be encountered during soil excavation and dewatering may be necessary in areas where groundwater is relatively shallow (within 15 feet of the ground surface). If dewatering is necessary, treatment of contaminated groundwater may be required. Research of existing groundwater analytical data that might be currently available in areas where dewatering may be required is recommended. Prior to discharge of water collected from dewatering activities, laboratory and analytical tests will be conducted for target analytes consistent with appropriate federal, state, or local regulations.

The following options for contaminated groundwater and disposal will be considered:

- Pump to tight tank or vacuum tank, with subsequent treatment/disposal off-site at an approved disposal or treatment facility.
- Discharge to a sanitary sewer, storm drain, or surface water body with the appropriate treatment, if necessary, and the appropriate permit or approval.

If treated groundwater will be discharged to surface water or a storm drain, National Pollutant Discharge Elimination System (NPDES) Surface Water Discharge Permit procedures will be followed. If treated groundwater will be discharged to a sanitary sewer, a Massachusetts Sewer System Extension and Connection Permit will be obtained. This option will likely require treating the groundwater prior to discharge and would require the use of a mobile treatment trailer on-site incorporating one or more treatment methods prior to discharge. Sampling of the treated effluent will also be conducted to ensure that the discharge requirements of the applicable permit are met.

7.10.5. MCP Reporting and Response Actions During Construction

Three types of notification thresholds have been established by the MA DEP: site conditions requiring notification within 120 days, 72-hours, and 2-hours of obtaining knowledge of the release. Such conditions are provided by telephone from the MBTA to the MA DEP with a written follow-up submittal of a Release Notification Form (RNF).

Under the MCP, construction activities cannot be initiated or continued at a site where a 2-hour or 72-hour notification requirement has been identified until an Immediate Response Action (IRA) has been undertaken and an IRA Completion Statement has been submitted to the MA DEP. If IRA conditions are encountered, it is the responsibility of the contractor to notify the MBTA, who will in turn notify the MA DEP and conduct the appropriate IRA activities.

Releases may also be encountered during construction activities that are not deemed time critical and as a result may be considered a 120-day reporting. For such releases, release abatement measures (RAMs)

can be performed. RAMs include such activities as soil excavation and installation of groundwater pump and treat systems. Similar to an IRA, a written RAM Plan will be submitted by the MBTA to the MA DEP followed by RAM Status Reports 120 days after commencement of the RAM and every six months thereafter, until submittal of the RAM Completion Report unless submittal of a Response Action Outcome (RAO) is made within that period.

An IRA is also required if an Imminent Hazard condition is encountered (or may pose an Imminent Hazard condition) during the work activities. Per 310 CMR 40.0412, an IRA is also required if a condition of Substantial Release Migration (SRM) is encountered.

7.10.6. Compliance with Applicable Regulations, Permits and Licenses

All regulated material handling conducted within the corridor will comply with the applicable regulations and laws of all authorities having jurisdiction including, but not limited to, MA DEP, U.S. Environmental Protection Agency (U.S. EPA), U.S. Department of Transportation (DOT), Massachusetts Water Resources Authority (MWRA), the Commonwealth of Massachusetts, and other applicable federal, state, and local agencies governing the disposal of contaminated soils.

During construction activities, compliance with relevant and current portions of all applicable regulations, policies, and guidance documents will be maintained, including but not limited to, the following:

- MA DEP Bureau of Waste Site Cleanup (BWSC), Interim Remediation Waste Management Policy for Petroleum Contaminated Soils (WSC #94-400), April 21, 1994.
- MA DEP Reuse and Disposal of Contaminated Soil at Massachusetts Landfills (Policy #COMM 97-001), April 1997
- MA DEP BWSC Bill of Lading Package (WSC 012)
- MA DEP Bureau of Waste Prevention (BWP), Material Shipping Record Log
- Board of Registration of Licensed Site Professionals, 309 CMR, as last amended
- MA DEP Policy for the Investigation, Assessment, and Remediation of Petroleum Releases (WSC #91-401) and Management Procedures for Excavated Soils Contaminated with Virgin Petroleum Oils (WSC #89-400)
- Federal Resource Conservation and Recovery Act (RCRA), as last amended
- Federal Toxic Substances Control Act, as last amended
- DOT Regulations applicable to the work
- U.S. EPA: 40 CFR 263 - 266
- Massachusetts Contingency Plan, 310 CMR 40.0000, as last amended, and EPA National Contingency Plan, as last amended
- Massachusetts Hazardous Waste Regulations, 310 CMR 30.000, as last amended
- Occupational Safety and Health Administration (OSHA) Standards: 29 CFR 1910 and 1926
- Superfund Amendments Reauthorization Act, PL-99-499, October 1986
- Posted weight limitations on roads and bridges

Plans for the handling of regulated materials will be shaped by the requirements of the referenced documents, but will also be guided by best management construction practices driven by cost management, long-term risk reduction, and, where possible, beneficial reuse.

7.10.7. Subcontractor Qualifications

Applicable license and insurance certificates of the licensed excavator and hauler(s) will be documented prior to commencement of construction activities. In addition, applicable licenses, permits, and approvals for disposal and recycling location(s) where contaminated soil will be disposed will be documented prior to the work. Documentation will be maintained which substantiates the suitability of proposed facilities to receive regulated materials. Material will not be sent to facilities that are actively considered by the MA DEP, U.S. EPA, or other responsible agency to be in violation of federal, state, or local hazardous waste or hazardous material regulations. It will be the responsibility of the Licensed Site Professional in charge of disposal of regulated material to document compliance with certification and permitting requirements for handling, transportation, and disposal activities.

All workers who perform activities in areas where contaminated media are known to exist will receive appropriate and safety training, including potentially forty hours of health and safety training for hazardous waste site operations (HAZWOPER) and 8 hours of refresher training each year after that, as required by EPA regulations, 29 CFR 19 CFR 1910.120.

7.11. Comparison of Project Segments and Summary of Impacts

The comparison of the project segments is presented below in Table 10. As shown in the table, the Ashland-Framingham segment would involve far lower construction costs and lesser property and natural resource impacts. The construction required in Worcester-Millbury-Grafton includes utility relocations and substantial areas of rock excavation and retaining wall construction to avoid or minimize impacts on adjoining residential and industrial/commercial properties, public properties, streets, and wetlands.

Table 10—Comparison of Ashland-Framingham and Worcester-Millbury-Grafton Project Segments

Category	Ashland-Framingham Improvements	Worcester-Millbury -Grafton Improvements
Length	1.7 miles	4.3 miles plus ½ mile extension of Worcester Yard lead
Cost	$5.811 million	$61.439 million
Bridgework Required	**Sudbury River Bridge and Framingham Reservoir No. 2 Bridge:** Reconstruct wingwalls and add 2-foot high headwall over culvert	**Putnam Lane:** Minor modifications **Plantation Street:** Ledge excavation **Hamilton Street:** Relocate west abutment and replace superstructure **Sunderland Road:** Widen bridge
# of Culvert Modified	None required.	It is anticipated that 14culverts will require lengthening.
Ledge	None required.	Substantial rock excavation required at a cost of roughly $10 million
Retaining Walls	240 linear feet adjoining Framingham Reservoir No. 2 at a cost of approximately $544,000	7,750 linear feet of walls (32 walls) at a cost of roughly $19 million
Utilities	Potential impacts to approximately 3,900 feet of fiber optic system along the tracks. This can be either relocated or a spare, empty conduit installed alongside the tracks in the event of future utility issues.	Track installation will require relocating 39 or 45 high-voltage utility poles. Potential impacts to approximately 1,750 feet of fiber optic system along the tracks. This can either be relocated or a spare, empty conduit installed alongside the tracks in the event of future utility issues.
Property Impacts	Impacts to approximately 4,110 square feet of property that includes parking for Ashland Technology Center. Option 2 would involve an additional impact totaling approximately 3,330 square feet at three properties, including municipal land, but is not recommended for further consideration.	Retaining wall construction would affect approximately 5,800 square feet at four properties, including three industrial uses. Lands affected consist of ledge or underutilized land adjoining the rail right-of-way and will not affect the use of the property.
Community Facilities	Option 1 (the preferred option) would avoid municipal land takings adjoining the Main Street grade crossing in downtown Ashland.	Work adjoining Ecotarium and North High School minimized through retaining walls
Environmental Justice	There are no Environmental Justice populations in this project segment.	Impacts on Environmental Justice populations in the vicinity of Tampa and Plantation Streets will be avoided through the use of retaining walls.

Table 10—Comparison of Ashland-Framingham and Worcester-Millbury-Grafton Project Segments

Category	Ashland-Framingham Improvements	Worcester-Millbury -Grafton Improvements
Parklands and Open Space	Work in proximity to Veterans Memorial Site in Ashland. Option 1 (the preferred option) would avoid direct impacts on this property.	Work in proximity to Perkins Conservation Area minimized through retaining wall and Lake Park on opposite side of tracks.
Section 4(f)	Option 1 would avoid municipal land takings at Main Street grade crossing, so that Section 4(f) would not apply.	No permanent effects on the Perkins Farm Conservation Area, although temporary disturbance for retaining wall construction will require coordination with local officials.
Noise and Vibration	13 noise-sensitive receptors would meet or exceed noise impact threshold. Six receptors meet or exceed vibration impact threshold.	18 noise-sensitive receptors would meet or exceed the noise impact threshold. Nine receptors meet or exceed vibration impact threshold.
Wetlands	Temporary alterations to approximately 200 square feet of land under water and roughly 40 lf of bank at Framingham Reservoir No. 2. Potential temporary impact to roughly 160 linear feet of bank at Framingham Reservoir No. 2	Alterations to approximately 4,700 square feet of bordering vegetated wetlands (Wetland C in Worcester) and approximately 300 square feet of isolated wetland (Wetland K) in Millbury.
Floodplains	Work at floodplains adjoining Sudbury River and Framingham Reservoir No. 2 Bridges will not affect flood-carrying capacity. Retaining wall installation at or above 100-year flood elevation.	No work within floodplains.
Rare Species	Work at Sudbury River Bridge will require occur within an Estimated Habitat/Priority Habitat for species of special concern, but will not involve work within the river.	Minimize impacts at edge of the Estimated Habitat for state-threatened species at Perkins Conservation Area through retaining wall construction.
Cultural Resources	Prior studies for the Worcester Commuter Rail Extension Project inventoried railroad bridges, adjoining buildings and included an intensive archaeological survey. No sites currently listed in the National or State Register of Historic Places. Coordination with MHC is underway.	
Oil and Hazardous Material	Listed sites are summarized in Table 4. Recommendations for soils management/groundwater handling during construction are in Section 7.10.	Listed sites are summarized in Table 5. Recommendations for soils management/groundwater handling during construction are in Section 7.10.

8. Other Potential Track Improvements for Worcester-Millbury-Grafton Segment

It is apparent that the improvements necessary to add a third track for 4.5 miles east from Worcester yard, as proposed by CSX, would require a significant amount of modifications, as described in the preceding sections. This includes utility relocations, disruption of customer service, major cuts and fills, numerous retaining structures, and impacts on wetlands and other environmentally sensitive areas. A question which arose immediately was whether the track needs to be extended all the way to CP39. It can only be surmised that the decision by CSX to recommend a tie-in at CP39 was based on two factors. Firstly, the option is a subset of the 2010 operations analysis, which indicates that an approximately 21 mile third track will be required (CP43 to CP23). Secondly, a logical tie-in location for a shorter lead would be at an existing interlocking (CP39).

The main purpose of the Worcester yard lead extension is to allow CSX to work the east end of Worcester Yard without occupying Main Line Track 2. Since under typical operations, CSX would only need to double up the longest track in the yard, it is assumed that a lead length extension of about 6,000 feet would be adequate for most, if not all current operating requirements. The longer extension to CP39 does allow through trains to clear the Main Line faster, however, the bigger benefit is from removing the interference from trains working the yard.

This arrangement may be further improved by eliminating CP39 and creating a new interlocking at CP42. A new interlocking at CP42 would further enhance the MBTA's ability to have commuter trains, that occasionally have to run reverse iron out of Worcester station, tie back into Track 2 heading east prior to CP39, a reduction of three miles of reverse running.

It should be noted that, although the overall improvements would be reduced, the more significant impacts are in the area immediately east of the Worcester yard and that area would still be impacted.

Although this was not a specific task for this undertaking, it may warrant further investigation, especially with regard to CSX's willingness to modify the option.

Yet another option might be to make improvements west of Worcester yard. Again, this was not reviewed extensively as part of this study. However, since most of CSX's operations are to and from the west and there are conflicts with interchange with the P&W railroad on the west end, improvements here may be more beneficial per dollar spent. Therefore, CSX may be willing to offset capacity improvements on the west to allow more commuter traffic to the east.

9. Regulatory and Permitting Requirements

It is recommended that the two project segments in Ashland-Framingham and in Worcester-Millbury-Grafton be advanced in a two-pronged approach and as separate, independent projects. These projects have independent utility, e.g., one can be constructed without the other, and thus can be permitted separately. This approach is recommended given both the complexity of the issues in the Worcester-Millbury-Grafton segment that would require a longer timeframe for project development and design, and the other available options that may potentially be considered for this area as described above (options for either shortening the yard lead, track improvements west of Worcester Yard, or some combination of these). The approvals that would be required for each project segment will include:

- **Categorical Exclusion under the National Environmental Policy Act** appears to the appropriate form of NEPA documentation. Federal regulation 23 CFR 771.117(c) contains a list of highway and transit related actions which meet the criteria for a Categorical Exclusion and normally do not require any further NEPA approvals by the Administration. This list includes track and rail bed maintenance and improvements when carried out within the existing right-of-way.
- **U.S. Army Corps of Engineers Programmatic General Permit (PGP)** will apply for both projects. The U.S. Corps of Engineers has regulatory jurisdiction under Section 404 of the U.S. Clean Water Act. A Category 1 Non-Reporting PGP may apply if the area of either permanent or temporary alteration of inland waterway and/or wetland fill is under 5,000 square feet. It appears that temporary alterations in Ashland-Framingham will not exceed a total of 5,000 square feet. If a Category 1 (non-reporting) PGP permit applies, the project may not require permit review by the U.S. Army Corps of Engineers. If temporary and permanent alterations equal or exceed 5,000 square feet, as appears to be the case in Worcester-Millbury-Grafton, a Category 2 (reporting) PGP permit application, but not an individual permit application, is required for review by the U.S. Army Corps of Engineers.
- **Notices of Intent under the Massachusetts Wetlands Protection Act** would be filed with the conservation commissions in Ashland, Framingham, Worcester, Millbury, and Grafton. It is anticipated that Orders of Conditions would be issued, since the project is not expected to exceed performance standards under the Massachusetts Wetlands Protection Act. In Worcester-Millbury-Grafton, the amount of bordering vegetated wetland impacted would total approximately 4,700 square feet. If this were to exceed the 5,000 foot performance standard, a Request for Variance under the Massachusetts Wetlands Protection Act would be required. The approval process for a Request for Variance is expected to take at least 1 year.
- **Water Quality Certification** from the MA DEP pertains to work within waterways, as mandated under Section 401 of the U.S. Clean Water Act. If the project involves 5,000 square feet or less cumulative loss of bordering and isolated vegetated wetlands, and a final Order of Conditions has been issued under the Massachusetts Wetlands Protection Act, the project may be excluded from review.
- **Massachusetts Endangered Species Act** reviews by the Massachusetts Natural Heritage and Endangered Species Program (MNHESP) would be required for work near rare species habitats in Ashland (Sudbury River) and Worcester (Perkins Farm Conservation Area). If required, permit applications for rare species habitat impacts will be submitted to MNHESP for review.
- **Massachusetts Department of Conservation and Recreation** approval may be required for wingwall reconstruction at the Framingham Reservoir No. 2 Bridge and for retaining wall

construction adjacent to the reservoir. Coordination with MDCR will be performed regarding the proposed work.

- **Massachusetts Historical Commission** has been notified through filing of a Project Notification Form and will be consulted on project design plans that are developed regarding potential effects on historic and archaeological resources in compliance with Section 106 of the National Historic Preservation Act and Massachusetts General Laws, Chapter 9, Sections 26-27C (950 CMR 71).
- **Massachusetts Highway Department Permit** may be required for any work within the MassHighway right-of-way for Route 20.
- **Notices of Intent/Stormwater Pollution Prevention Plans** under the National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit would be prepared. Under the NPDES permit program, disturbance of 1 acre or more will require preparation of a Stormwater Pollution Prevention Plan outlining erosion and sedimentation controls to be implemented on the site, and Notices of Intent would need to be filed with the U.S. Environmental Protection Agency and the Massachusetts Department of Environmental Protection for coverage under the general permit.

It is anticipated that environmental impacts can be substantially reduced through installation of retaining walls that are shown in this report and on the attached track plans (Figures 13A-13J and Figures 14A-14X). Installation of these walls will substantially reduce the permitting requirements for the project. If, during subsequent design phases, retaining walls are not incorporated as shown in this report, additional permits and regulatory approvals will likely be required. These could include a Request for a Variance under the Massachusetts Wetlands Protection Act for alteration of greater than 5,000 square feet of bordering vegetated wetlands and filings required under the Massachusetts Environmental Policy Act.

For instance, use of a retaining wall at the Perkins Farm Conservation Area will eliminate the need for approvals under Section 4(f) of the U.S. Department of Transportation Act and legislative approvals under Article 97 of the Massachusetts Constitution. A temporary easement may be required for the retaining wall installation, but this temporary occupancy will not constitute a use of 4(f) resource when all of the conditions set forth in 23 CFR 771.135(p)(7) are met. These conditions include:

- temporary duration and no change in ownership,
- minor scope of work and nature and magnitude of the changes to the 4(f) resource are minimal,
- no permanent adverse impacts and no temporary or permanent interference with activities on the resource,
- land must be fully restored and returned to condition as good as pre-construction, and
- there must be documented agreement of the appropriate federal, state, or local officials having jurisdiction over the resource regarding the above conditions.

The last condition will require coordination and written documentation with the Worcester Conservation Commission regarding the nature of temporary work affecting the Perkins Farm Conservation Area. Review of mapping indicates that the retaining wall may intersect portions of a 120-foot section of trail that extends into the right-of-way from the conservation property. However, work entirely within the CSX right-of-way would not be subject to Section 4(f).

10. Findings and Recommendations

10.1. Design Options

The focus of this study was the recommendation made in the CSX Study for extension of the Framingham and Worcester Yard leads. The basic configuration of the proposed track improvements evaluated in this report is to add the third track on the south side of the tracks in Framingham and Worcester to function as the freight yard leads from Nevins and Worcester Yards. CSX recommended extending the freight leads from Nevins Yard to CP24 in Ashland and from Worcester Yard to CP39 in Grafton. One significant modification proposed in the Ashland-Framingham project segment is to truncate the Framingham track extension to end prior to CP24 in Ashland to avoid the Main and Cherry Street grade crossings.

In addition to the CSX proposed options evaluated in this report for the Worcester-Millbury-Grafton project segment, other design options that have been identified in this report for further consideration as alternatives to the proposed 4.3 miles of track improvements (plus ½ mile freight yard lead) due to the constrained nature of the right-of-way in this project segment include:

- **Option to Terminate Yard Lead 6,000 feet East of Worcester Yard:** Although extending the third track all the way to CP39 would allow CSX freight trains to clear the main line sooner, it would be a very expensive arrangement and would involve considerable impacts. An option to consider would be to reduce the amount of track extension by terminating the track extension approximately 6,000 feet east of the yard. This is based on the minimum track length to accommodate CSX staging and assembling of trains from Worcester Yard, which would be equal to doubling of the longest track in the yard. Most of the ledge impacts occur in this section of track, so substantial rock excavation and retaining wall construction would still be required. Eliminating CP39 and creating an interlocking at CP42 could further improve this arrangement.
- **Options west of Worcester Yard:** Options west of Worcester Yard may provide improvements in CSX freight service at substantially lower costs. An example of improvements might include track lead extensions at the west end of the CSX Worcester Yard. These options could be implemented in addition to, or in lieu of, improvements to the Worcester Yard lead.

For the track improvements, there are options identified in this report for specific project segments, which can be developed for further consideration. These options for further consideration include:

- **Ashland Main Street grade crossing:** As discussed above, of the two options for tying back into the Main Line, Option 1, which terminates east of Main Street, is preferred. Option 2 would terminate west of Main Street and would involve an additional grade crossing.
- **Framingham Reservoir No. 2:** Options to minimize proximity to the reservoir include either retaining wall construction (Option 1) or realignment of the tracks bordering on Framingham Reservoir No. 2 in Framingham (Option 2).
- **Hamilton Street Bridge:** Options to accommodate the track addition under the bridge include either superstructure replacement, relocation of the west bridge abutment, new wingwall construction, and ledge removal (under Option 1) or realignment of the tracks to avoid bridge modifications (under Option 2).
- **Sunderland Road Bridge:** Track realignments to accommodate the track addition on the east side of the bridge are proposed, along with bridge modifications, but in addition, a more costly option at this location to lower the profile of Sunderland Road to improve vertical clearances could be considered.
- **Utility Relocations:** Options include relocation of either 39 or 45 of the high-voltage transmission line poles in Worcester–Millbury-Grafton and either constructing the tracks over the fiber-optic line at five or six locations (for a total distance of roughly 1 mile) in both Ashland-Framingham and Worcester-Millbury-Grafton or relocating the fiber-optic line alongside the proposed track.
- **Retaining Walls:** A conservative approach was taken in locating retaining walls, which were assumed to be installed wherever property impacts and wetland impacts could be avoided, regardless of the type of property impact. Further refinements in the locations of walls to reduce costs without incurring substantial impacts to adjoining properties or natural resources are recommended, should the project proceed to subsequent design phases. Changes in these wall locations could change regulatory approvals and permits required that are presented in Section 9.

With further study, assessments can be made as to the feasibility of the different design options. In some cases, the feasibility of an option may change as a result of more advanced design or newer information. Additional study of the alternative options for the Worcester-Millbury-Grafton segment (e.g., shorter yard lead) would influence some of these options. Additional information could include input from entities, such as CSX, MassHighway, the affected municipalities, contiguous abutters, or other projects in the same area. An example might be a bridge that is not currently planned for upgrade or replacement nor is it on the Transportation Improvement Program, but may become part of a capital plan later.

Some of the options involve line shifts of all tracks. To the extent possible, modifications to the existing tracks were avoided to minimize disruptions to operations on the rail lines. These disruptions would impact CSX, MBTA, and Amtrak. In some instances, however, complete line shifts were made when it provided economic or environmental gains. These line shifts were made in existing curves to take advantage of the existing change in alignment. This avoided the unnecessary addition of curves to keep the tracks within the existing right-of-way.

The use of walls was employed to mitigate impacts on environment (wetland, rare species habitat), minimize the need for easements and takings on adjacent properties, and reduce the need for substantial cuts or fills or protection of existing infrastructure and utilities. Walls and supporting structures, as it turns out are the most expensive portion of the Worcester to Grafton segment of the project, accounting for $19 million of the total cost. A conservative approach was taken to locating walls to avoid property impacts, and reducing the number or length of retaining walls would reduce project costs, but would increase property impacts, environmental impacts, and possibly permitting requirements.

10.2. Environmental Impacts and Permitting

The property impacts in the Ashland-Framingham segment, assuming the preferred option for the track improvements terminating east of Main Street (Option 1), would consist of approximately 4,110 square feet of property that includes parking for the Ashland Technology Center. The majority of the parking area will not be affected by the track improvements.

In Worcester-Millbury-Grafton, the majority of property impacts would be avoided through installation of retaining walls. However, a total of approximately 5,800 square feet of property within four parcels would be affected. The land affected is either undevelopable ledge or located within industrial parcels, and would not affect the current use of the properties.

The Ashland-Framingham portion of the track improvements would involve temporary disturbances to waterways or wetlands, but no permanent impacts are anticipated as a result of the track improvements. This work will involve temporary disturbance within Framingham Reservoir No. 2 for wingwall replacement at the bridge over the reservoir (affecting approximately 200 square feet of land under water and approximately 40 linear feet of bank). In addition, possible installation of a retaining wall separating the proposed track and the reservoir would affect approximately 160 linear feet of bank. This work will require filings with the Framingham and Ashland Conservation Commissions under the Massachusetts Wetlands Protection Act and coordination with the Massachusetts Department of Conservation and Recreation, which has jurisdiction over Framingham Reservoir No. 2

The Worcester-Millbury-Grafton segment will involve permanent alterations to approximately 4,700 square feet of bordering vegetated wetlands and approximately 300 square feet of isolated wetlands. Temporary alterations to approximately 315 square feet are also anticipated. Wetlands temporarily affected will be restored, and permanent alterations will be mitigated through creation of wetland replication areas. This work will require review and approval from the U.S. Army Corps of Engineers (Programmatic General Permit, Category 2) and the local conservation commissions in Worcester, Millbury, and Grafton (Notices of Intent under the Massachusetts Wetlands Protection Act).

Work within both Ashland-Framingham and the Worcester-Millbury-Grafton segments will extend within designated rare species habitats, which will require review by the Massachusetts Natural Heritage

and Endangered Species Program under the Massachusetts Endangered Species Act.

Coordination with the Massachusetts Historical Commission (MHC) has been initiated through filing of a Project Notification Form for the Worcester Commuter Rail Service Improvements. Consultation with MHC will continue regarding potential effects on historic and archaeological resources as project design plans are developed.

It is recommended that the Ashland-Framingham and Worcester-Millbury-Grafton segments be considered two separate projects from a permitting standpoint, as each segment has independent utility. Review of retaining walls identified in this report for the Worcester-Millbury-Grafton segment is also recommended, given the considerable costs involved, since a conservative approach in locating walls was taken to minimize property and environmental impacts. However, additional property and environmental impacts that may result from this review of wall locations could affect the permits and regulatory approvals required for the project, which are outlined in Section 9.

10.3. Implementation and Phasing

The key finding of this report is that the Ashland-Framingham segment is more cost-effective and more easily implementable than the Worcester-Millbury-Grafton segment. The Worcester Yard lead extension will be very expensive and will take longer to implement and construct, due to the significant amount of ledge and resulting land takings, cuts, walls, and relocation of the high voltage lines and poles. The estimated construction cost for the Worcester to Grafton segment is roughly $61.439 million for 4.8 miles of track improvements, compared to roughly $5.811 million for the Ashland-Framingham improvements to 1.7 miles of track.

Because of the significant effort and cost required to develop the Worcester Yard lead extensions, it is recommended that the Ashland-Framingham segment of the project be advanced separately. It is anticipated that the planning, design, and construction of the Worcester to Grafton segment would take longer to complete than the Ashland-Framingham portion, given the extent of bridge modifications and utility relocations required and geotechnical investigations needed. Moreover, further consideration of other design options identified in this report (Option to terminate yard lead 6,000 feet east of Worcester Yard and Options west of Worcester Yard) for the Worcester-Millbury-Grafton segment may be warranted, since the service level benefits associated with the longer track extension to CP39 may not justify the considerable costs and impacts involved.

Developing a two-pronged approach for these projects would be useful from a cost, construction, and coordination standpoint. Under a two-pronged or phased approach, these projects can be designed, permitted, and developed separately. These projects, for the purposes of permitting and regulatory review, have independent utility and can be considered as two separate and independent projects. Each project may then be advanced independently of the other.

The recommendations and costs reflected in this study are based upon the alignments shown on the track plans. These track alignments were used to develop all related costs and impacts. This includes bridges, culverts, utilities, earth cuts and fills, retaining walls, rock stabilization, land takings, and environmental remediation.

10.3.1. Policy and Coordination Issues

Policy issues include coordination with external entities for implementation of the proposed track improvements, as well as improvements to underpassing and overpassing bridges and structures. This includes agencies with jurisdiction, affected municipalities, property owners, and the public.

Reconstruction of the bridges at Hamilton Street and Sunderland Road will require coordination with both the City of Worcester and the Massachusetts Highway Department. The retaining wall construction along the Worcester-Millbury-Grafton segment will require coordination with property owners for obtaining access, and possibly even construction or temporary easements.

It should be noted that the project goals and objectives did not include addressing freight clearance issues, as envisioned under the Massachusetts Double Stack Initiative. Funding for this initiative is under a 50-50 cost sharing arrangement between the Commonwealth and the participating railroads. Currently, some sections of track can only accommodate clearance for only one full-sized 9.5-foot container and one smaller 8.5-foot container. Under this initiative, the Commonwealth plans to improve overhead clearances on a number of freight railroad lines to the height needed to accommodate full double-stack container trains (20'-8").

10.4. Public and Stakeholder Issues

Input from the public and stakeholders were identified through a series of meetings in both Framingham and Worcester. The focus of the public and stakeholder input was concentrated in two areas. The first issue relates to how quickly the necessary improvements could be made and train service expanded. The second issue relates to the impact of additional train service on the neighborhoods and in particular, at grade crossings. Framingham was most interested in the potential impact of additional trains causing further delays at the Concord Street/Route 126 crossing in Framingham center. Although the exact type and level of commuter rail service is unknown, it was indicated that there will not be a significant, and perhaps no, increase in the number of commuter trains crossing this grade crossing. An increase in commuter rail service will be represented by the extension of service to Worcester by the trains that presently transit the crossing and stop in Framingham before making a return trip to Boston. These trains would instead continue on to Worcester instead of turning around at Framingham Station. The number of CSX trains which cross at Route 126 is purely a function of CSX freight operations and the demand for freight, as this market either contracts or expands in the future. All indications are that CSX business will grow; however, there are ongoing discussions with regard to changing how CSX operates in eastern Massachusetts, particularly between Beacon Park and Worcester.

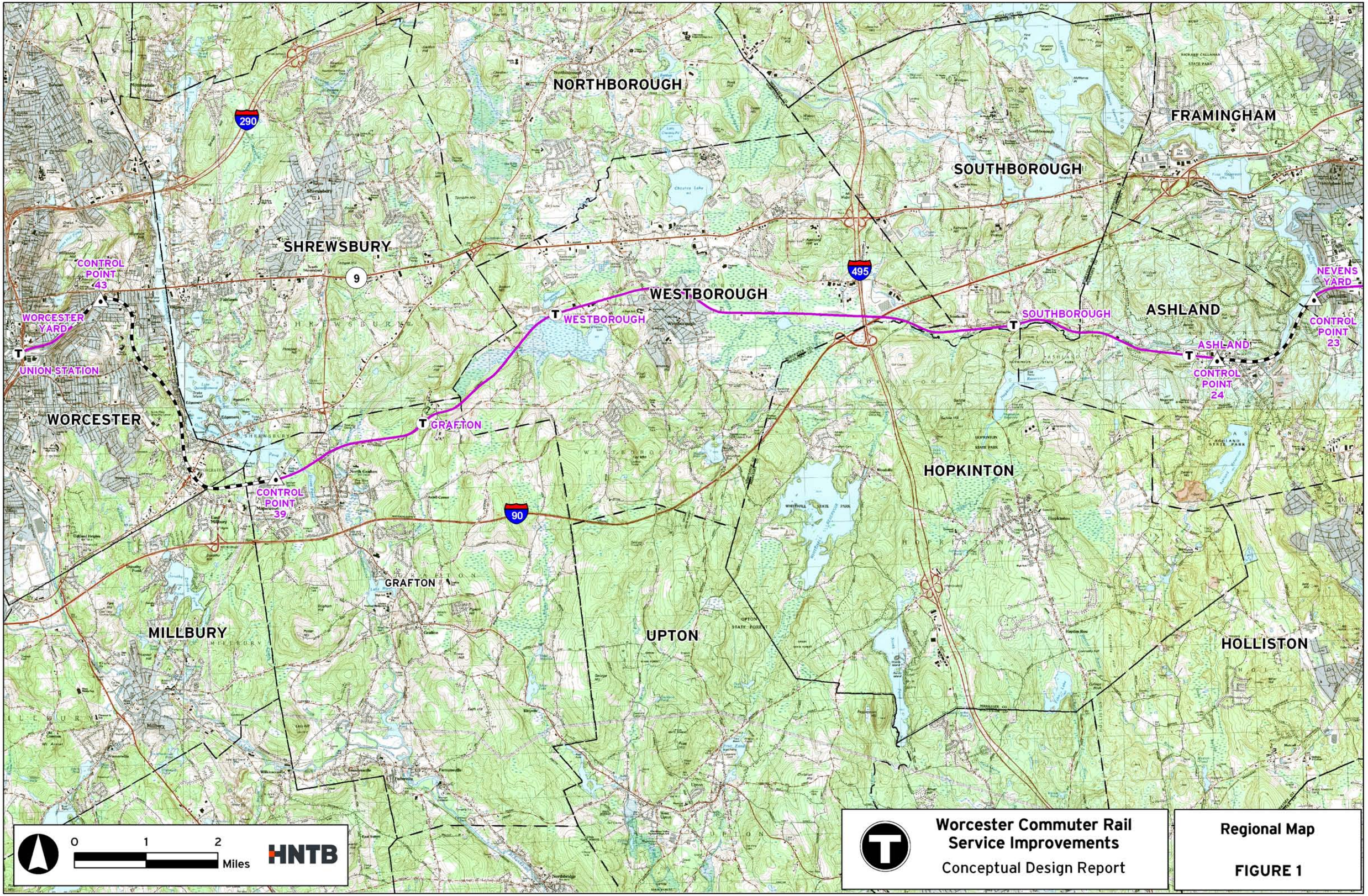
10.5. CSX Coordination

There are a number of issues that require coordination with CSX and either additional information from, or approval by, CSX. These include:

- Agreement on the track center spacing assumed in this report (13 feet),
- Agreement on the use of the maintenance access road in Ashland-Framingham for the track locations,
- Agreement on shortening the Ashland track connection to relocate this tie-in east of Main Street,
- Other option to be considered for shortening the Worcester Yard lead,
- Other option to be considered for track improvements west of Worcester Yard,
- Utilities agreements and responsible party for costs of utility relocations,
- Better property line information,

Since it is has been nearly two years since this study was initiated, the next step would be for the MBTA to discuss the findings and recommendations of this study with CSX and determine, in the ever-changing rail climate, if there is a solution to introducing more commuter rail service and to explore whether it could be introduced in a phased fashion. This would give the MBTA time to establish funding, determine if a phased increase in service warrants further investment, and to see if changes in the CSX rail operations offer other alternatives to increasing commuter rail service.

Based on discussions with MBTA Commuter Rail staff and a review of the MBTA/CSX operating agreements, it is recommended that, for capital improvements that the MBTA may decide to fund, a specific agreement be reached as to the total number of additional trains that can be added to the line, even if that number is not added initially.



Worcester Commuter Rail Service Improvements

Conceptual Design Report

Regional Map

FIGURE 1

SOUTHBOROUGH

ASHLAND

FRAMINGHAM

EXIT 12

90

Reservoir #3

Reservoir #1

Reservoir #2

Farm Pond

Waushakum Pond

Winter Street

Fitchburg Secondary Line

Framingham Secondary Line

Hollliston Secondary Line

Framingham Reservoir #2

Waverly Street

Sudbury River

Front Street

Homer Avenue

Cherry Street

Main Street

Control Point 23

Control Point 24

Nevens Yard

Auto Yard

CP Yard

FRAMINGHAM

ASHLAND

126

135

0 0.3 0.6 Miles

HNTB

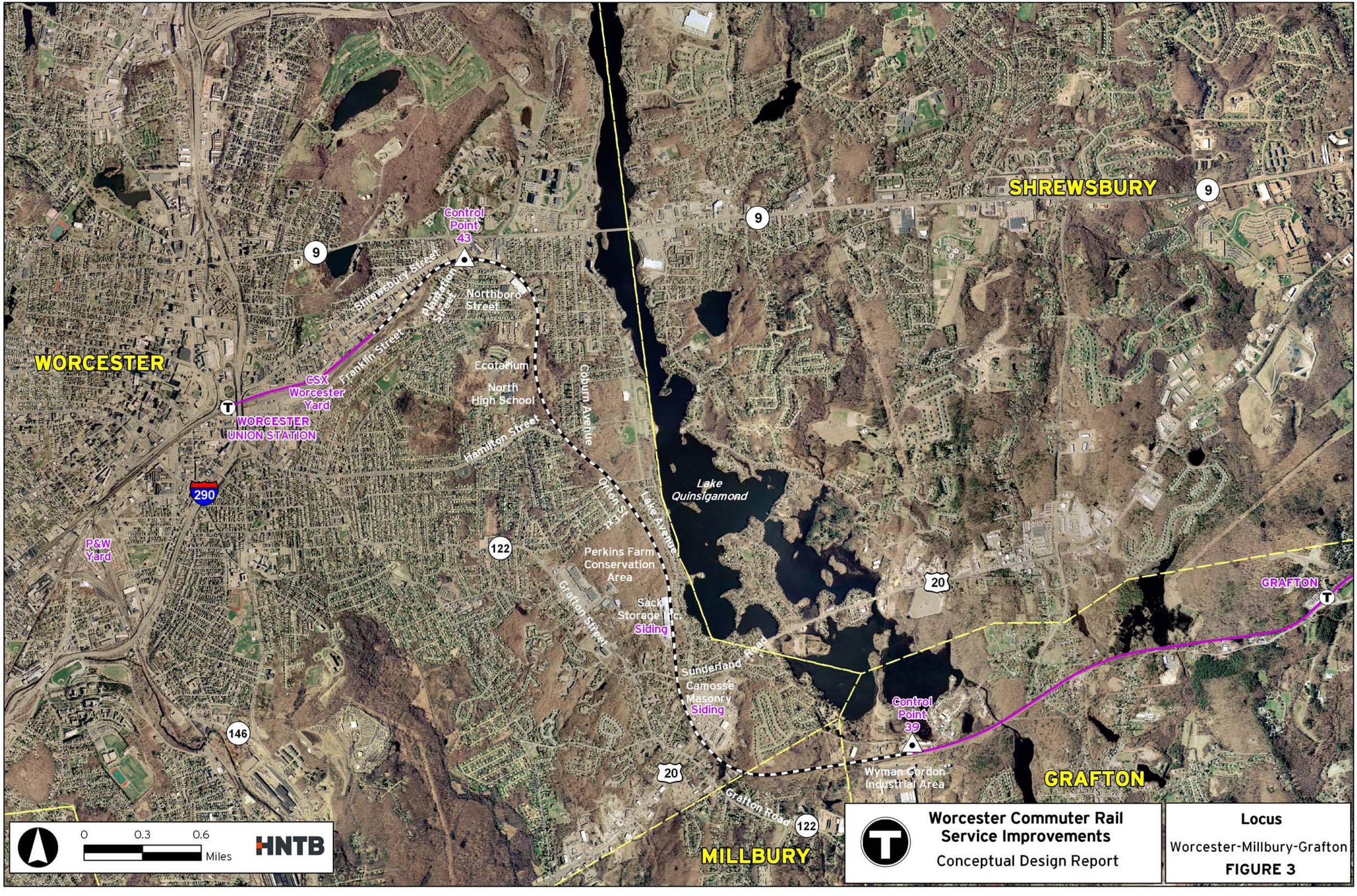
Worcester Commuter Rail Service Improvements

Conceptual Design Report

Locus

Ashland-Framingham

FIGURE 2


WORCESTER
SHREWSBURY
MILLBURY
GRAFTON
Control Point 43
Control Point 39
CSX Worcester Yard
WORCESTER UNION STATION
P&W Yard
Shrewsbury Street
Plantation Street
Northboro Street
Franklin Street
Ecotarium
North High School
Coburn Avenue
Hamilton Street
Lake Avenue
Quinsigamond Ave Ext
Grafton Street
Perkins Farm Conservation Area
Sack Storage Inc Siding
Sunderland Camosse Masonry Siding
Wyman Gordon Industrial Area
Grafton Road
Lake Quinsigamond
290
9
122
20
146
0
0.3
0.6
Miles
HNTB
Worcester Commuter Rail Service Improvements
Conceptual Design Report
Locus
Worcester-Millbury-Grafton
FIGURE 3

Ashland Zoning

- Downtown Commerce
- Highway Commerce
- Industrial
- Mixed Use Special District
- Multifamily dwelling
- Neighborhood Commerce
- Residential A
- Residential B
- Village Commerce

FRAMINGHAM

ASHLAND

Farm Pond

Framingham Reservoir #2

Nevens Yard

Control Point 23

135

Framingham Reservoir #2

Fountain Street

Waverly Street

Sudbury River

Control Point 24

ASHLAND

Front Street

Homer Avenue

Cherry Street

Main Street

Union Street

135

135

LEGEND

- Project Limits
- Commuter Rail Track
- Environmental Justice Population

Zoning

See Insets for Town Zoning Legends

Source: Executive Office of Environmental Affairs, MassGIS

Framingham Zoning

- Business
- Central Business
- General Manufacturing
- General Residence
- Geriatric Care/Elderly Housing
- Office and Professional
- Open Space/Recreation
- Planned Reuse
- Single Residence 1
- Single Residence 3
- Single Residence 4

0 0.15 0.3 Miles

HNTB

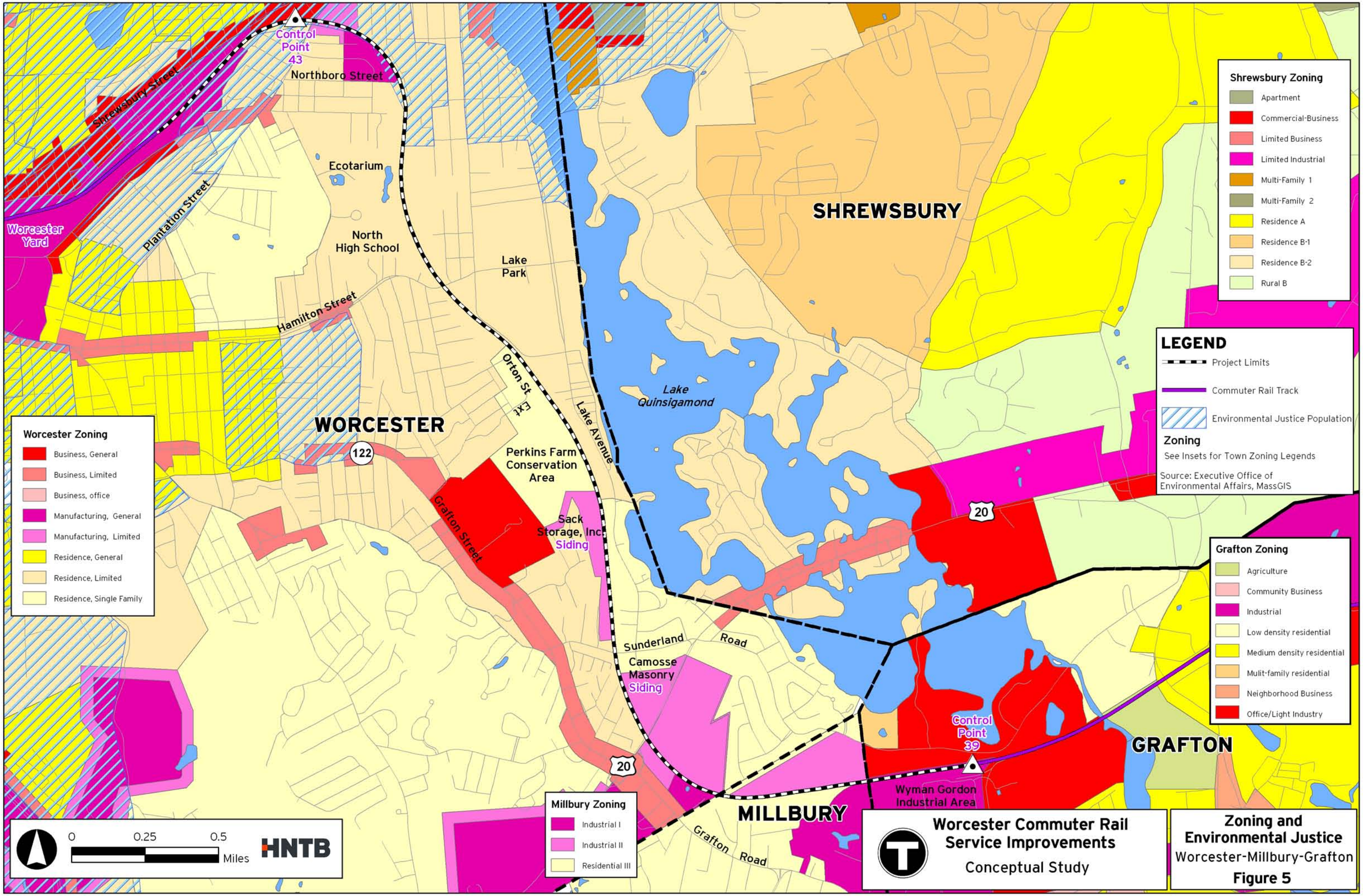
Worcester Commuter Rail Service Improvements

Conceptual Design Report

Zoning and Environmental Justice

Ashland-Framingham

Figure 4


Control Point 43
Northboro Street
Shrewsbury Street
Plantation Street
Worcester Yard
Ecotarium
North High School
Lake Park
Hamilton Street
WORCESTER
122
Orton St
Ext
Lake Avenue
Perkins Farm Conservation Area
Grafton Street
Sack Storage, Inc. Siding
Sunderland Road
Camosse Masonry Siding
20
Lake Quinsigamond
SHREWSBURY
Control Point 39
Wyman Gordon Industrial Area
MILLBURY
GRAFTON
Grafton Road
Shrewsbury Zoning
Apartment
Commercial-Business
Limited Business
Limited Industrial
Multi-Family 1
Multi-Family 2
Residence A
Residence B-1
Residence B-2
Rural B
LEGEND
Project Limits
Commuter Rail Track
Environmental Justice Population
Zoning
See Insets for Town Zoning Legends
Source: Executive Office of Environmental Affairs, MassGIS
Worcester Zoning
Business, General
Business, Limited
Business, office
Manufacturing, General
Manufacturing, Limited
Residence, General
Residence, Limited
Residence, Single Family
Grafton Zoning
Agriculture
Community Business
Industrial
Low density residential
Medium density residential
Mulit-family residential
Neighborhood Business
Office/Light Industry
Millbury Zoning
Industrial I
Industrial II
Residential III
0
0.25
0.5
Miles
HNTB
Worcester Commuter Rail Service Improvements
Conceptual Study
Zoning and Environmental Justice
Worcester-Millbury-Grafton
Figure 5

Cowasock Brook
Ashland Town Forest
City Forest
FRAMINGHAM
Framingham Reservoir #2
Sudbury Reservoir
Nixon Street
Cushing Hospital
Barbieri Middle School
Farm Pond
Keefe Technical School
Longs Field Complex
Vo-tech High School
Ice Skating Ar
Nevens Yard
Control Point 23
135
Roosevelt School
Ashland Open Space Land2
Abandoned Well
ASHLAND
Ashland Open Space Land2
Waverly Street
Anna M
Sudbury River Park 2
Mindess Middle School
Fountain Street
Framingham Reservoir #2
135
Bethany Convent
Pond
Control Point 24
ASHLAND
Sudbury River
Front Street
Kadra Estate
Bates Park
Homer Avenue
Main Street
Union Street
135
Cherry Street
Stone Park
Wildwood Cemetery
Abandoned Pumping Station
Rocco Parcel
Pout Rock
Ashland State Park
Condo Trust

LEGEND

- ProjectLimits
- Federal
- DCR-State Parks & Recreation
- DCRS/DFG
- Department of Fish & Game
- DCR-Urban Parks & Recreation
- DCR-Water Supply Protection
- Department of Agricultural Resources
- Commonwealth of Massachusetts
- County
- Municipal
- Public Non-Profit
- Land Trust
- Conservation Organization
- Non-Profit
- Private
- Other
- Unknown
- State Register of Historic Places(Districts)
- State Register of Historic Places(Points)

Source: Executive Office of Environmental Affairs, MassGIS

0 0.15 0.3 Miles

HNTB

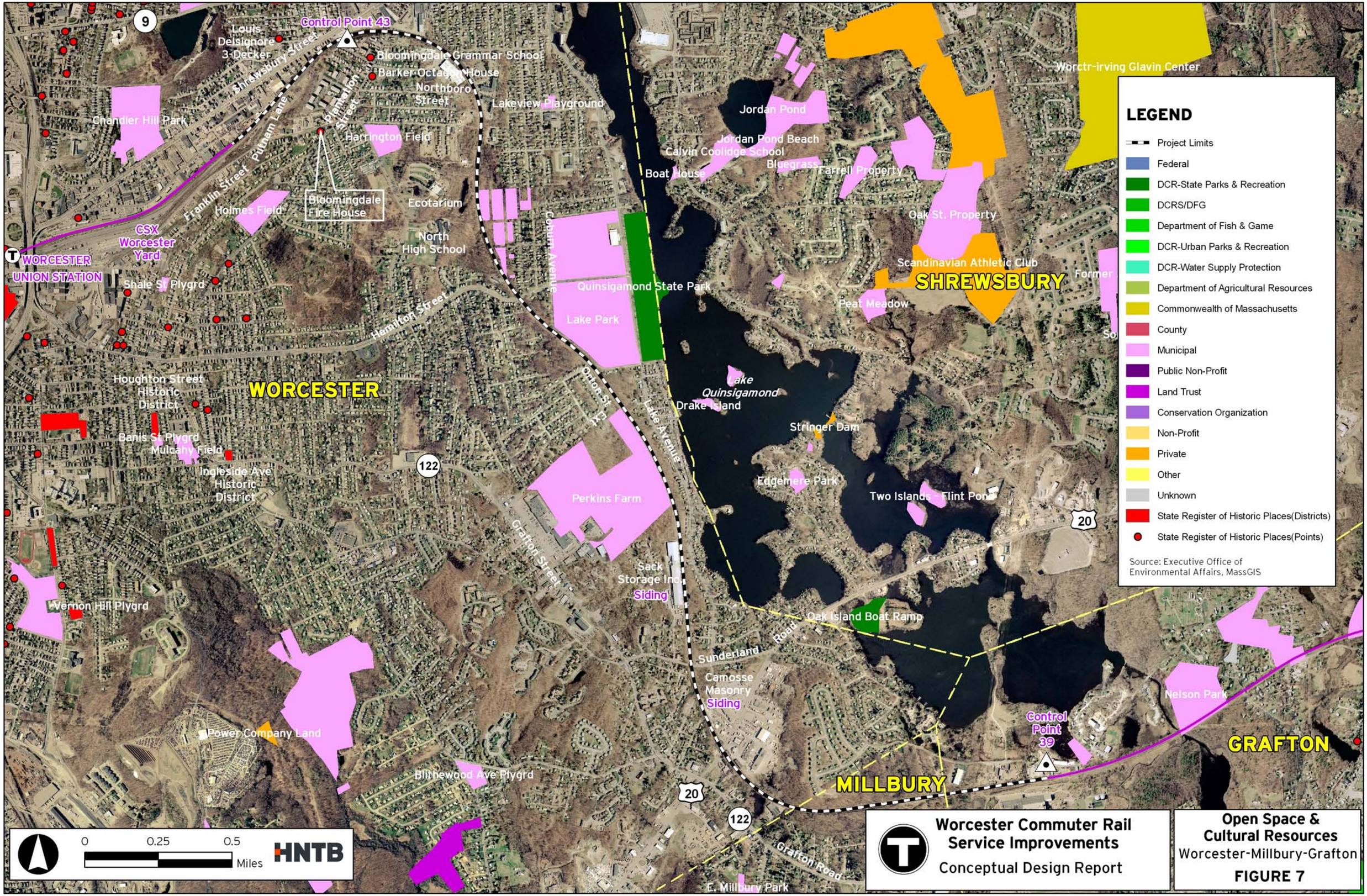
Worcester Commuter Rail Service Improvements

Schematic Design Report

Open Space & Cultural Resources

Ashland-Framingham

FIGURE 6


Control Point 43
Louis Delsignore 3-Decker
Shrewsbury Street
Bloomingdale Grammar School
Barker Octagon House
Northboro Street
Lakeview Playground
Worctr-irving Glavin Center
Chandler Hill Park
Putnam Lane
Plimpton Street
Harrington Field
Jordan Pond
Jordan Pond Beach
Calvin Coolidge School
Bluegrass
Farrell Property
Boat House
Franklin Street
Holmes Field
Bloomingdale Fire House
Ecotarium
Coburn Avenue
Oak St. Property
CSX Worcester Yard
North High School
WORCESTER UNION STATION
Scandinavian Athletic Club
SHREWSBURY
Former
Shale St Plygrd
Quinsigamond State Park
Peat Meadow
Hamilton Street
Lake Park
Houghton Street Historic District
WORCESTER
Lake Quinsigamond
Drake Island
Stringer Dam
Orton St Ext
Lake Avenue
Banis St Plygrd
Mulcahy Field
Ingleside Ave Historic District
Edgemere Park
Two Islands - Flint Pond
Perkins Farm
Grafton Street
Sack Storage Inc. Siding
Vernon Hill Plygrd
Oak Island Boat Ramp
Sunderland Road
Camosse Masonry Siding
Nelson Park
Control Point 39
Power Company Land
Blithewood Ave Plygrd
MILLBURY
GRAFTON
E. Millbury Park
Grafton Road
LEGEND
Project Limits
Federal
DCR-State Parks & Recreation
DCRS/DFG
Department of Fish & Game
DCR-Urban Parks & Recreation
DCR-Water Supply Protection
Department of Agricultural Resources
Commonwealth of Massachusetts
County
Municipal
Public Non-Profit
Land Trust
Conservation Organization
Non-Profit
Private
Other
Unknown
State Register of Historic Places(Districts)
State Register of Historic Places(Points)
Source: Executive Office of Environmental Affairs, MassGIS
0
0.25
0.5
Miles
HNTB
Worcester Commuter Rail Service Improvements
Conceptual Design Report
Open Space & Cultural Resources
Worcester-Millbury-Grafton
FIGURE 7

FRAMINGHAM

ASHLAND

Reservoir #2

Winter Street

Nevens Yard

Control Point 23

135

Framingham Reservoir #2

Waverly Street

Fountain Street

Waushakum Pond

Control Point 24

Sudbury River

Front Street

Homer Avenue

LEGEND

- MBTA Worcester Commuter Rail Line
- ProjectLimits

DEP Wetlands

- Bog
- Deep Marsh
- Shallow Marsh Meadow
- Shrub Swamp
- Wooded Swamp Deciduous
- Wooded Swamp Mixed

FEMA Flood Zones

- 100-Year Floodplain
- 500-Year Floodplain

MNHESP Protected Habitats

- Massachusetts Certified Vernal Pools (2005)
- Priority Habitat for State-Protected Rare Species (2005)
- Estimated Habitat for Rare Wildlife (2005)

Source: Executive Office of Environmental Affairs, MassGIS

0 0.2 0.4 Miles

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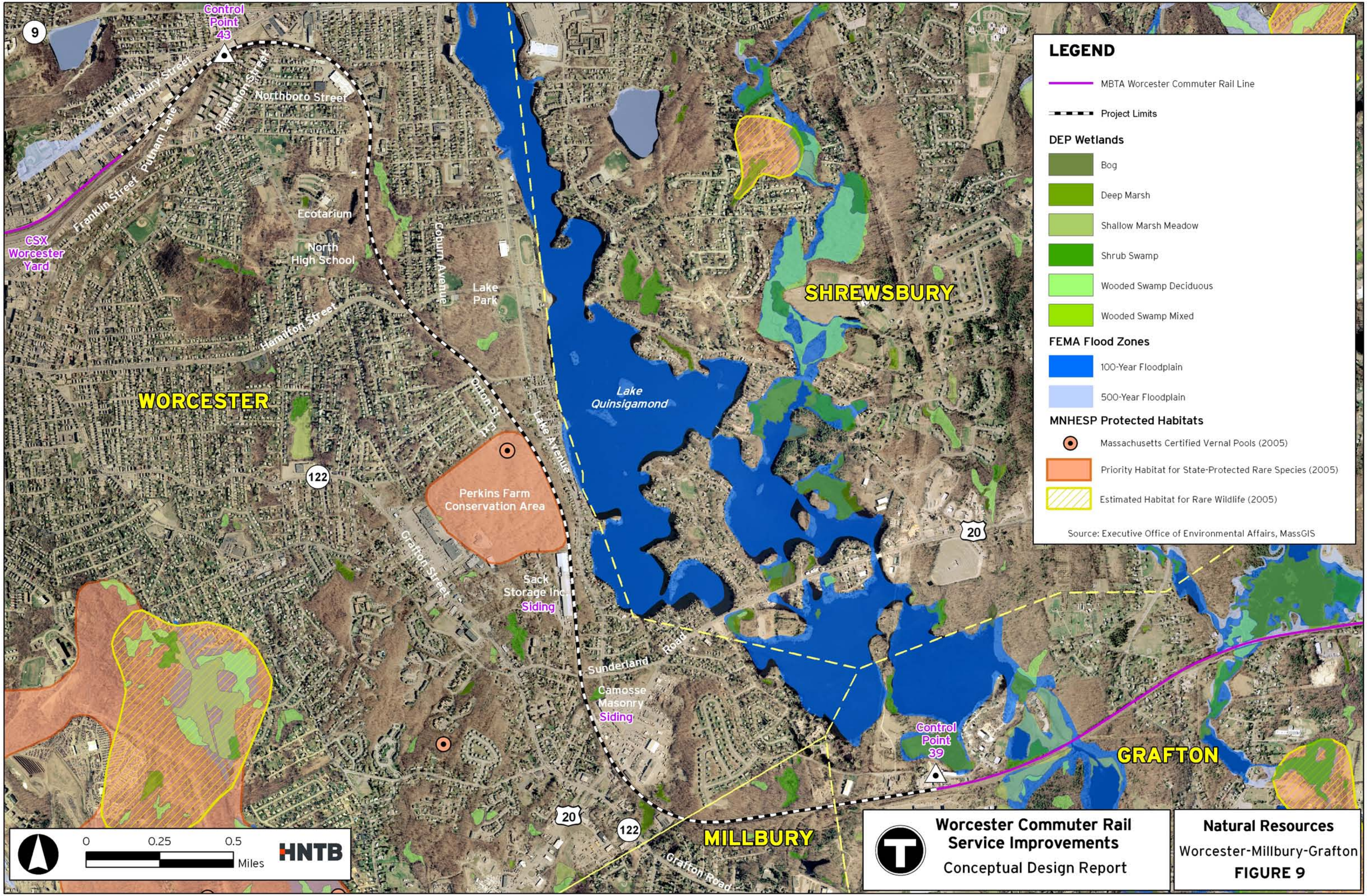
Worcester Commuter Rail Service Improvements

Conceptual Design Report

Natural Resources

Ashland-Framingham

FIGURE 8


Control Point 43
9
Shrewsbury Street
Northboro Street
Plantation Street
Putnam Lane
Franklin Street
CSX Worcester Yard
Ecotarium
North High School
Coburn Avenue
Lake Park
Hamilton Street
WORCESTER
SHREWSBURY
Lake Quinsigamond
Union St
Lake Avenue
122
Perkins Farm Conservation Area
Grafton Street
Sack Storage Inc Siding
Sunderland Road
Camosse Masonry Siding
20
Control Point 39
GRAFTON
MILLBURY
Grafton Road
LEGEND
MBTA Worcester Commuter Rail Line
Project Limits
DEP Wetlands
Bog
Deep Marsh
Shallow Marsh Meadow
Shrub Swamp
Wooded Swamp Deciduous
Wooded Swamp Mixed
FEMA Flood Zones
100-Year Floodplain
500-Year Floodplain
MNHESP Protected Habitats
Massachusetts Certified Vernal Pools (2005)
Priority Habitat for State-Protected Rare Species (2005)
Estimated Habitat for Rare Wildlife (2005)
Source: Executive Office of Environmental Affairs, MassGIS
0
0.25
0.5
Miles
HNTB
Worcester Commuter Rail Service Improvements
Conceptual Design Report
Natural Resources
Worcester-Millbury-Grafton
FIGURE 9

FRAMINGHAM

ASHLAND

Reservoir #2

Farm Pond

Winter Street

Nevens Yard

Control Point 23

Control Point 24

135

Framingham Reservoir #2

Waverly Street

Fountain Street

Waushakum Pond

Sudbury River

Front Street

Homer Avenue

Main Street

Union Street

Cherry Street

LEGEND

MBTA Worcester Commuter Rail Line

Project Limits

Aquifers By Yield

- High
- Med

DEP Listed Sites

DEP Tier Classified 21E Sites

- Tier 1A
- Tier 1B
- Tier 1C
- Tier 1D
- Tier II

DEP Bureau of Waste Prevention

- Large Quantity Toxic Users
- Large Quantity Generator of EPA/RCRA-regulated Hazardous Waste
- Large Quantity Generator of MA-regulated Hazardous Waste
- Hazardous Waste Recyclers
- Hazardous Waste Treatment, Storage and/or Disposal Facilities
- Underground Storage Tank Locations
- Solid Waste Facilities

Source: Executive Office of Environmental Affairs, MassGIS

0 0.1 0.2 Miles

HNTB

Worcester Commuter Rail Service Improvements

Conceptual Design Report

Aquifers & Hazardous Waste

Ashland-Framingham

FIGURE 10

Control Point 43
9
Shrewsbury Street
Plantation Street
Northboro Street
Putnam Lane
Franklin Street
CSX Worcester Yard
Ecotarium
North High School
County Avenue
Lake Park
Hamilton Street
WORCESTER
SHREWSBURY
Lake Quinsigamond
Orion St Ext
Lake Avenue
122
Perkins Farm Conservation Area
Grafton Street
Sack Storage Inc Siding
Sunderland Road
Camosse Masonry Siding
20
122
MILLBURY
Grafton Road
Control Point 39
GRAFTON
20

LEGEND

MBTA Worcester Commuter Rail Line

Project Limits

Aquifers By Yield

High

Med

DEP Listed Sites

DEP Tier Classified 21E Sites

Tier 1A

Tier 1B

Tier 1C

Tier 1D

Tier II

DEP Bureau of Waste Prevention

Large Quantity Toxic Users

Large Quantity Generator of EPA/RCRA-Regulated Hazardous Waste

Large Quantity Generator of MA-Regulated Hazardous Waste

Hazardous Waste Recyclers

Hazardous Waste Treatment, Storage and/or Disposal Facilities

Underground Storage Tank Locations

Solid Waste Facilities

Source: Executive Office of Environmental Affairs, MassGIS

0 0.25 0.5 Miles

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Aquifers & Hazardous Waste

Worcester-Millbury-Grafton

FIGURE 11

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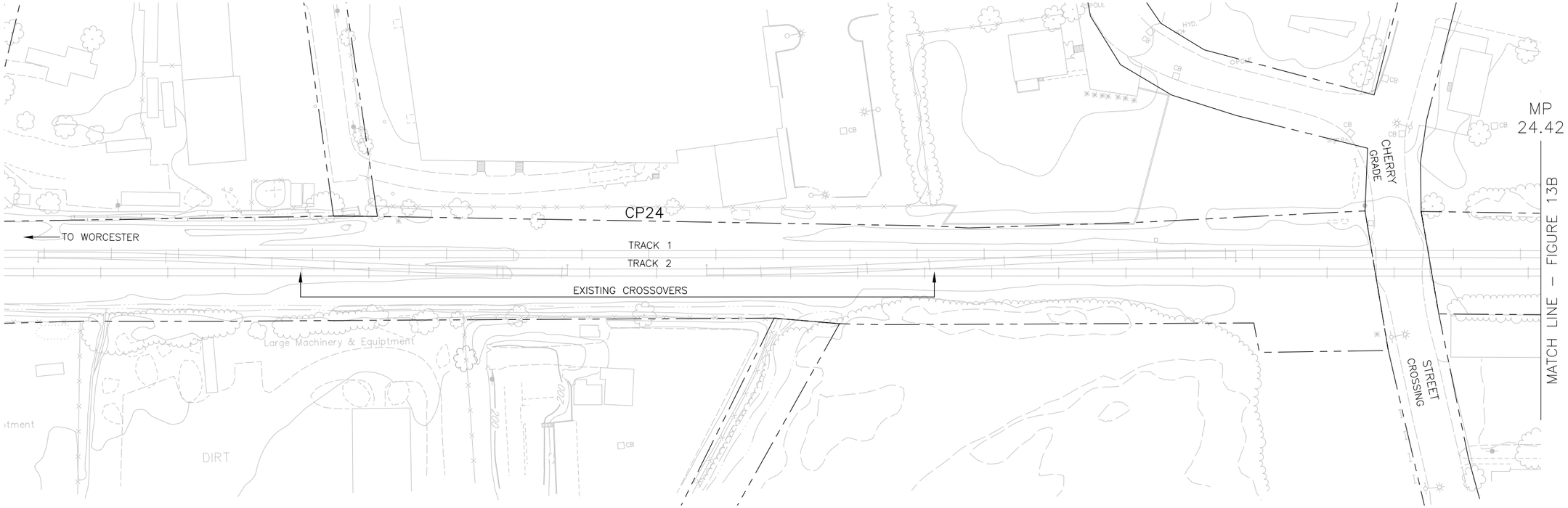
Track Chart

FIGURE 12

P:\JOBS\39285 Worcester Third Track\TechProd\Cadd\Worcester Track Chart.dwg, 5/16/2006 6:41:25 AM



LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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Track Plan
Ashland

FIGURE 13A

MP 24.42

MATCH LINE – FIGURE 13A

MP 24.21

MATCH LINE – FIGURE 13C

ASHLAND POLICE STATION

ASHLAND CENTRAL FIRE STATION

ASHLAND WAR MEMORIAL

POTENTIAL PROPERTY IMPACT

18" C.I. PIPE CULV. 24.39 INSPECT, CLEAN, MODIFY

PROPOSED NO. 20 TURNOUT (OPTION 2)

TRACK 1

TRACK 2

PROPOSED THIRD TRACK

MAIN

GRADE

RELOCATE SIGNALS AND GATES

NEW TRACK CROSSING

PROPOSED NO. 20 TURNOUT (OPTION 1)

FORMER RAIL STATION (CHARLES RIVER MEDICAL ASSOCIATES)

STREET

CROSSING

VIEW FROM ASHLAND POLICE/FIRE PARKING LOT

PROPERTY CLOSE TO ROW

PROPOSED 3RD TRACK TO LEFT. RELOCATE SIGNALS AND GATES UNDER OPTION 1

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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Track Plan
Ashland

FIGURE 13B

P:\JOBS\39285 Worcester Third Track\TechProd\Cadd\TP13A-133.dwg, 5/15/2006 1:58:03 PM

ASHLAND TECHNOLOGY CENTER PARKING POTENTIAL PROPERTY CONFLICT

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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Worcester Commuter Rail Service Improvements

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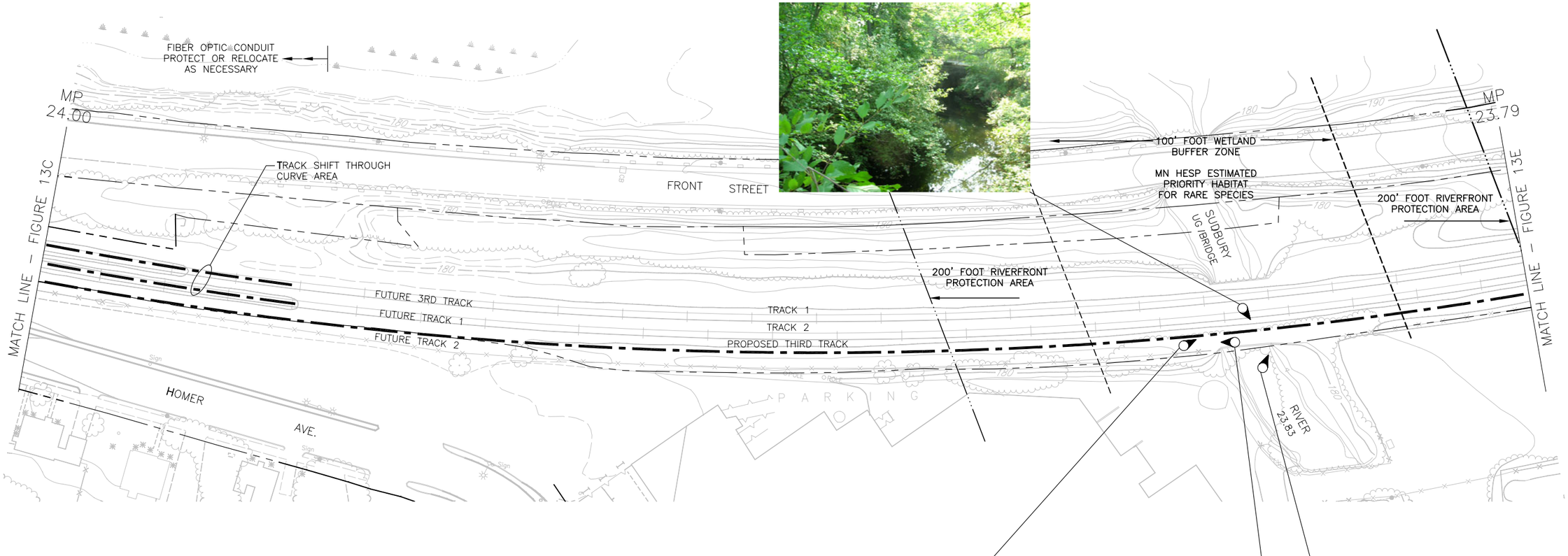
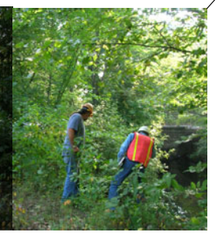
Ashland

FIGURE 13C





SUDBURY RIVER BRIDGE (MP 23.83)

THIS IS APPROXIMATELY 42 FOOT LONG SINGLE–SPAN CONCRETE ENCASED STEEL GIRDER BRIDGE. THERE IS ENOUGH BRIDGE WIDTH AVAILABLE SOUTH OF EXISTING TRACKS TO ACCOMMODATE NEW TRACK. NEW HEADWALLS WILL BE REQUIRED AT BRIDGE ENDS.

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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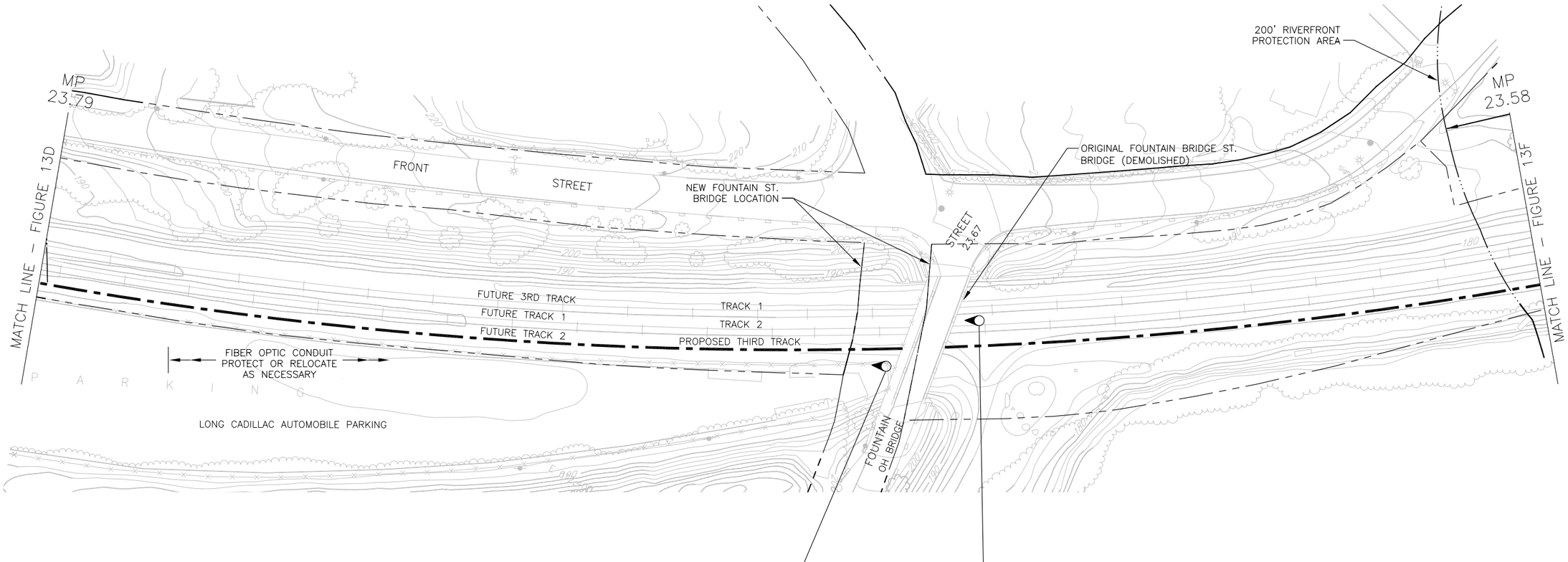
FIGURE 13D

P:\JOBS\39285 Worcester Third Track\TechProd\Cadd\TP13A-133.dwg, 5/15/2006 2:57:51 PM



PARKING AREA BEYOND

NEW FOUNTAIN ST. BRIDGE (MP 23.67)

THIS IS A 3–SPAN STEEL GIRDER BRIDGE WITH CONCRETE DECK. THERE IS ENOUGH WIDTH BETWEEN SOUTHERN MOST EXISTING TRACK AND SOUTH PIER TO ACCOMMODATE THE NEW TRACK.

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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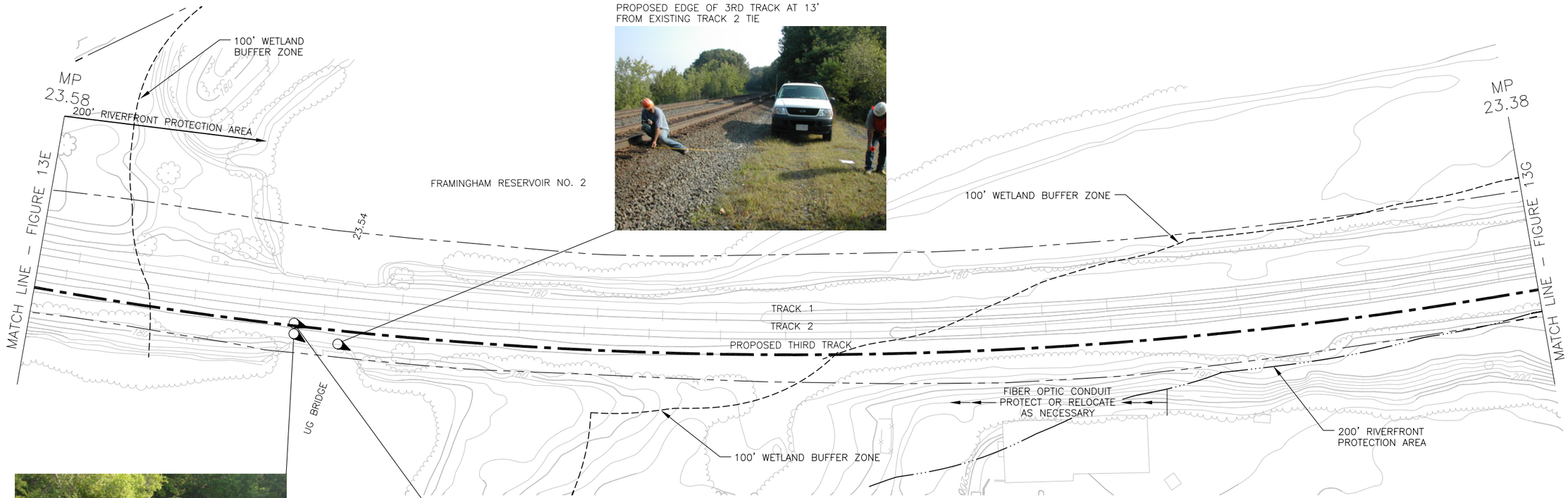
Worcester Commuter Rail Service Improvements
Conceptual Design Report

Track Plan
Ashland

FIGURE 13E

P:\JOBS\39285 Worcester Third Track\TechProd\Cadd\TP13A-13J.dwg, 5/16/2006 5:27:47 AM



SUDBURY RIVER BRIDGE (MP 23.54)

THIS BRIDGE IS A 2–BARREL STONE ARCH CULVERT. THERE IS ENOUGH BRIDGE WIDTH AVAILABLE SOUTH OF EXISTING TRACKS TO ACCOMMODATE NEW TRACK. NEW HEADWALLS WILL BE REQUIRED AT BRIDGE ENDS.

VIEW LOOKING EAST OF FRAMINGHAM RESERVOIR NO. 2 BRIDGE (ALSO KNOWN AS SUDBURY RIVER BRIDGE MP 23.54)

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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Ashland

FIGURE 13F

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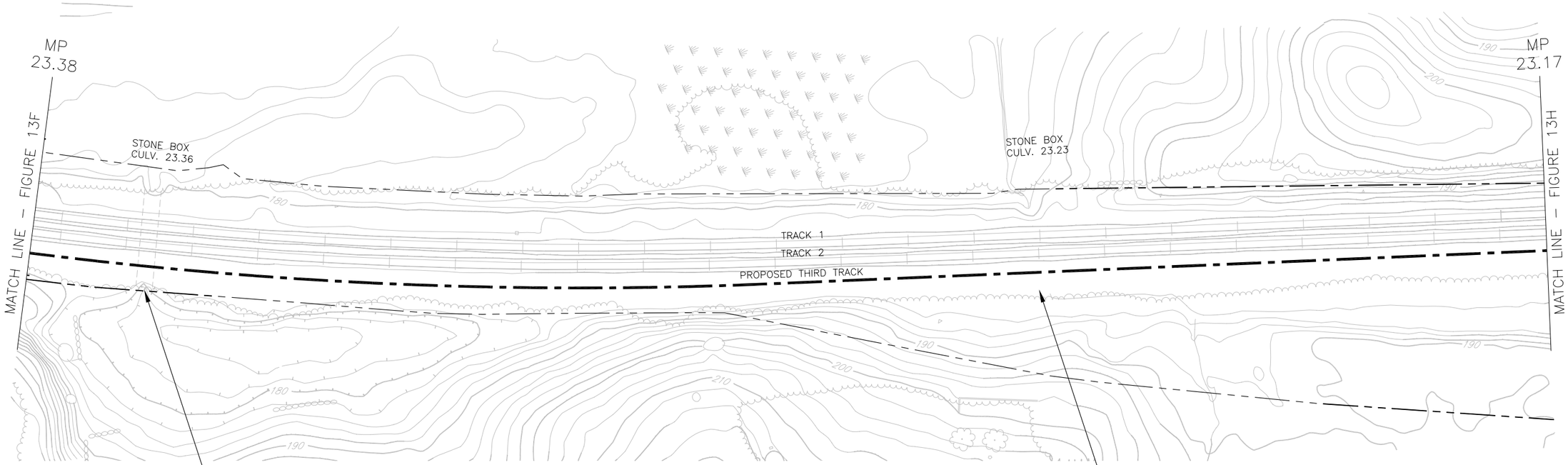

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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Ashland

FIGURE 13G

MP 23.17

MATCH LINE – FIGURE 13G

FIBER OPTIC CONDUIT PROTECT OR RELOCATE AS NECESSARY

STONE BOX CULV: 23.10 INSPECT, CLEAN, MODIFY

EXISTING TRACK 1

EXISTING TRACK 2

PROPOSED 3RD TRACK

FUTURE 3RD TRACK

FUTURE TRACK 1

FUTURE TRACK 2

TRACK SHIFT THROUGH CURVE AREA

MP 23

MP 22.96

MATCH LINE – FIGURE 13I

2'x1'6" STONE BOX CULVERT WITH 8' EARTH COVER

VIEW LOOKING NORTH (MP 23.10) AT AREA OF OBSCURED CULVERT

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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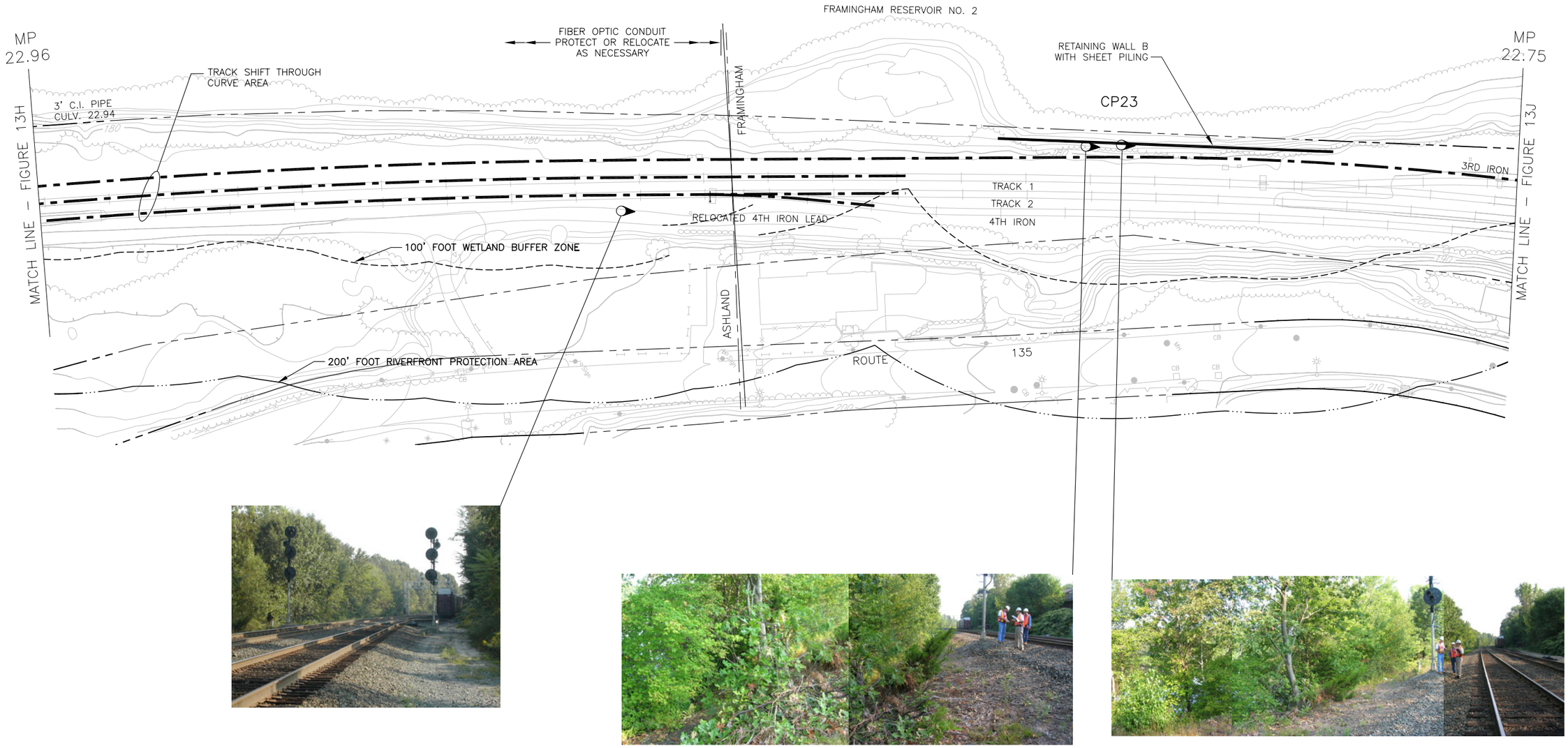
Ashland

FIGURE 13H

P:\JOBS\39285 Worcester Third Track\TechProd\Cadd\TP13A-13I.dwg, 5/16/2006 6:02:21 AM



LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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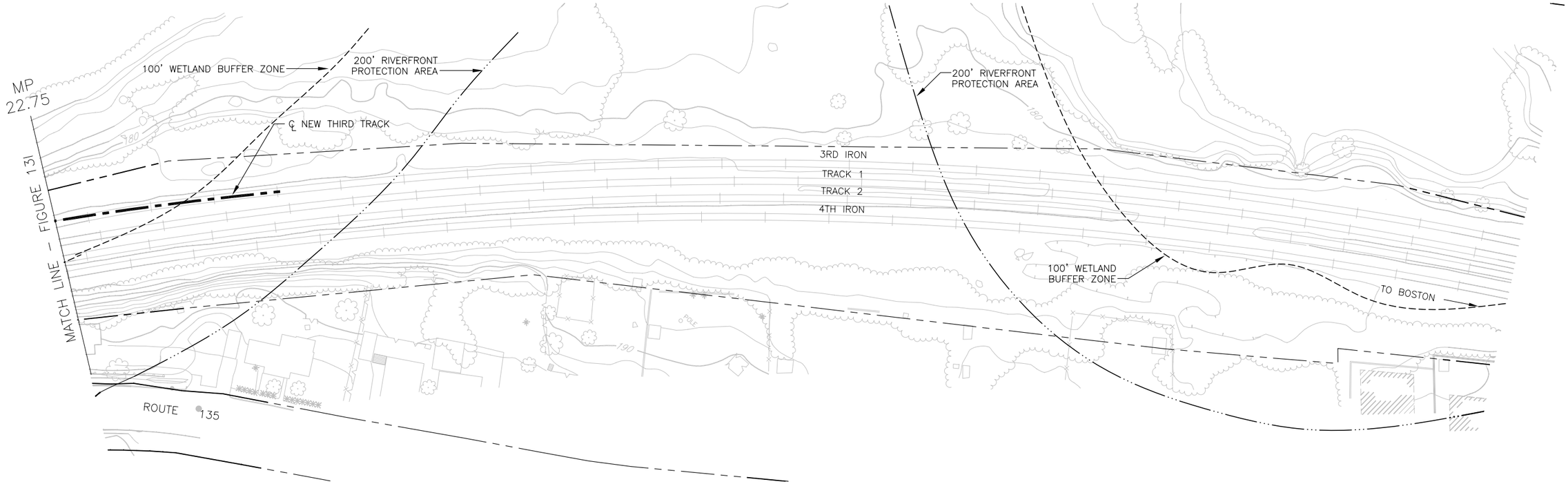
Worcester Commuter Rail Service Improvements

Conceptual Design Report

Track Plan
Ashland-Framingham

FIGURE 13I



LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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Worcester Commuter Rail Service Improvements

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Track Plan
Framingham

FIGURE 13J

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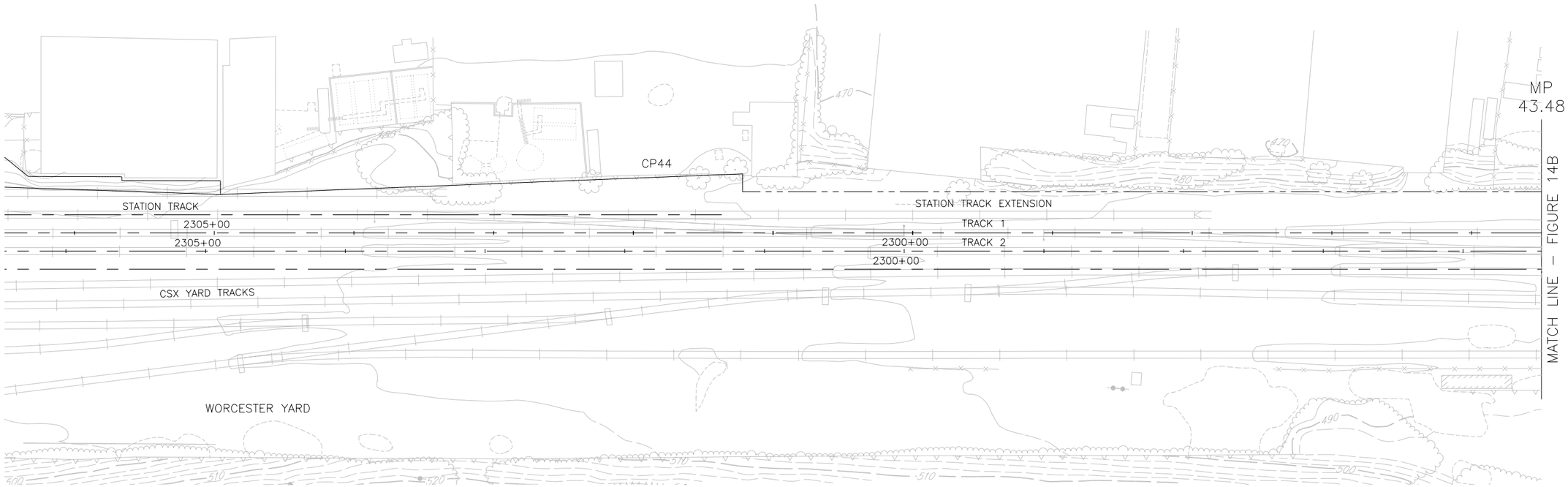

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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Worcester Commuter Rail Service Improvements

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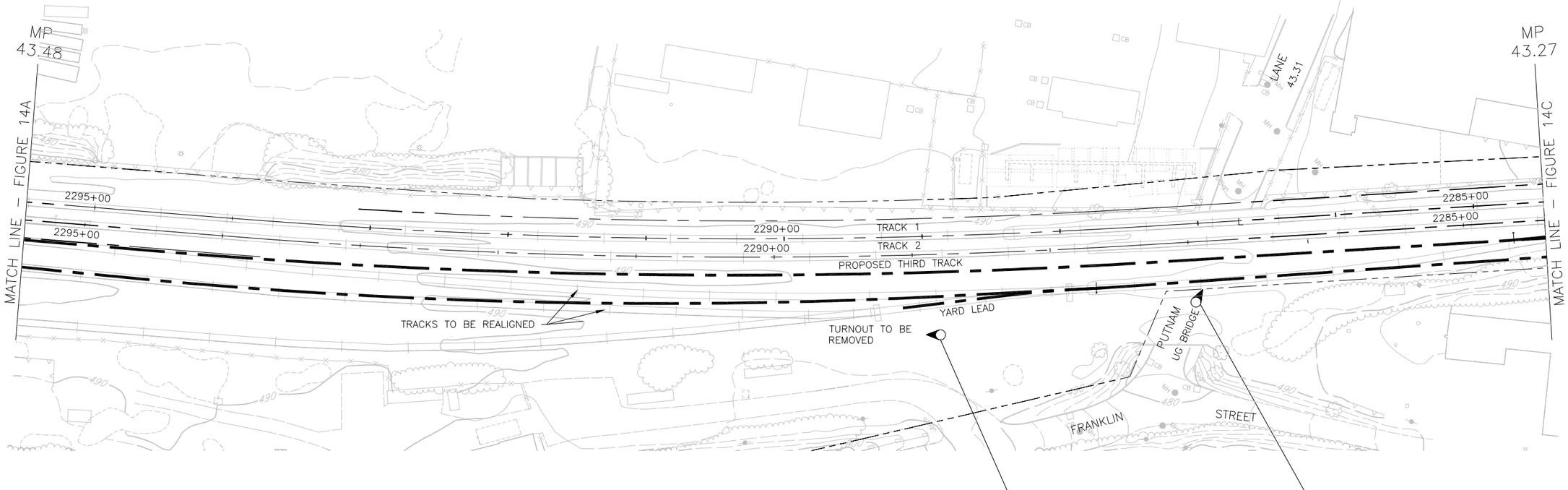
Worcester

FIGURE 14A



WORCESTER FREIGHT/YARD LEAD

PUTNAM LANE UNDER RR (MP 43.31)

COMBINATION SINGLE–SPAN AND 3–SPAN RIVETED STEEL GIRDER BRIDGE WITH CONCRETE DECK. SUPERSTRUCTURE IN GOOD VISUAL CONDITION. REPAIRS REQUIRED AT THE EAST ABUTMENT. NEW TRACK CAN BE ACCOMMODATED BETWEEN MAIN TRACKS AND LEAD YARD TRACK.

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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Worcester Commuter Rail Service Improvements

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FIGURE 14B

MP 43.27

MATCH LINE – FIGURE 14B

MP 43.06

MATCH LINE – FIGURE 14D

DRIVE

PRIVATE

CP43

HELCA STREET

DRAPER STREET

DRIVE

PRIVATE

2280+00

2280+00

TRACK 1

TRACK 2

2275+00

2275+00

PROPOSED THIRD TRACK

PROPOSED NO. 10 TURNOUT

POTENTIAL STAGING AREA NO. 1

POTENTIAL STAGING AREA NO. 1
(FORMER DRIVING RANGE)

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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Worcester

FIGURE 14C

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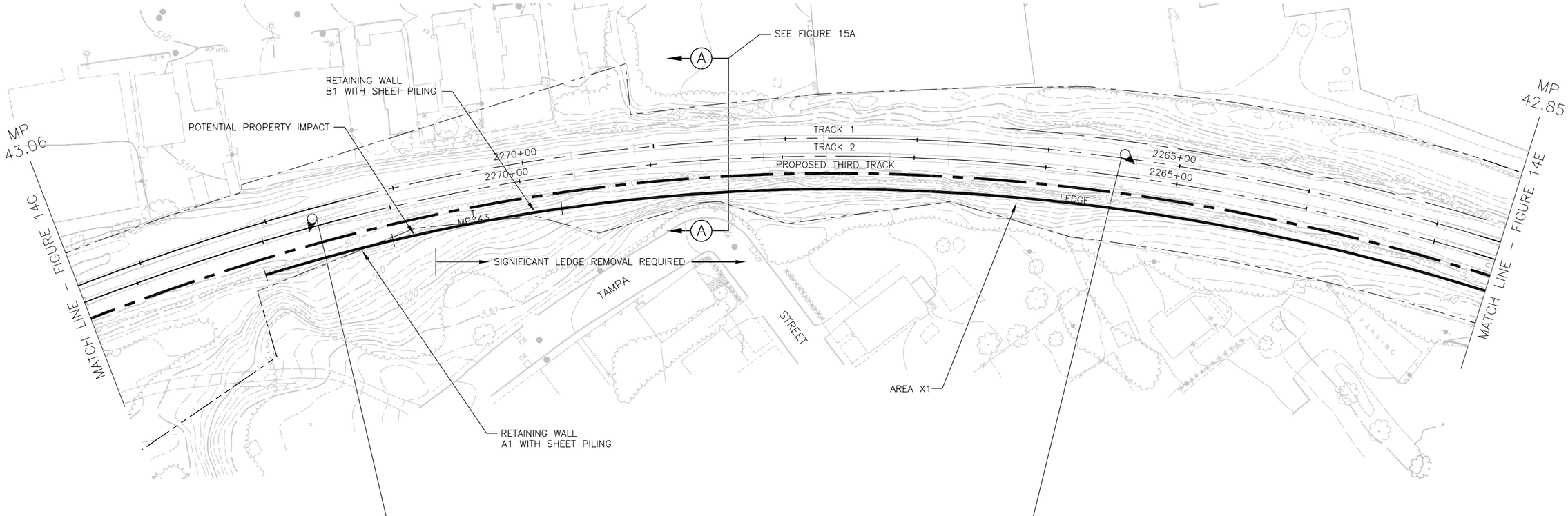

VIEW LOOKING SOUTH AT PROPERTY ADJOINING FENCE

VIEW LOOKING SOUTHEAST AT LEDGE ADJOINING SOUTH SIDE OF TRACK AND PROPERTY LINE AT TOP OF LEDGE (MILEPOST 42.85)

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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FIGURE 14D

MP 42.85

MATCH LINE – FIGURE 14D

MP 42.64

MATCH LINE – FIGURE 14F

AREA X2

2260+00

2260+00

SIGNIFICANT LEDGE REMOVAL

STREET 42.78

PLANTATION OH BRIDGE

TRACK 1

TRACK 2

PROPOSED THIRD TRACK

LEDGE

2255+00

2255+00

AREA X3

RETAINING WALL C1

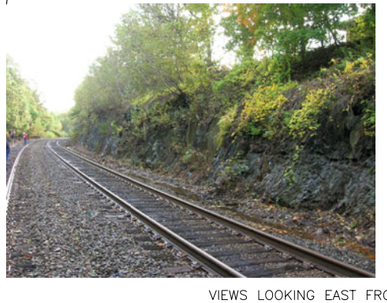
SIGNIFICANT LEDGE REMOVAL

PARKING

PLANTATION STREET UNDER RR (MP 42.78)

THIS IS A SINGLE–SPAN RIVETED STEEL PLATE GIRDER BRIDGE WITH CONCRETE DECK. INSTALLATION OF NEW TRACK SOUTH SIDE OF EXISTING TRACKS WOULD REQUIRE PORTION OF ROCK LEDGE TO BE REMOVED IN FRONT OF SOUTH ABUTMENT

VIEWS LOOKING SOUTHWEST, AT SOUTH ABUTMENT FOR PLANTATION STREET BRIDGE, AND AT FENCING AT TOP OF LEDGE FOR ADJOINING PROPERTY/DRIVE, RESPECTIVELY



VIEWS LOOKING EAST FROM PLANTATION STREET BRIDGE AND VIEW LOOKING SOUTH FROM TRACKS, EAST OF PLANTATION STREET BRIDGE, RESPECTIVELY

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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Worcester Commuter Rail Service Improvements

Conceptual Design Report

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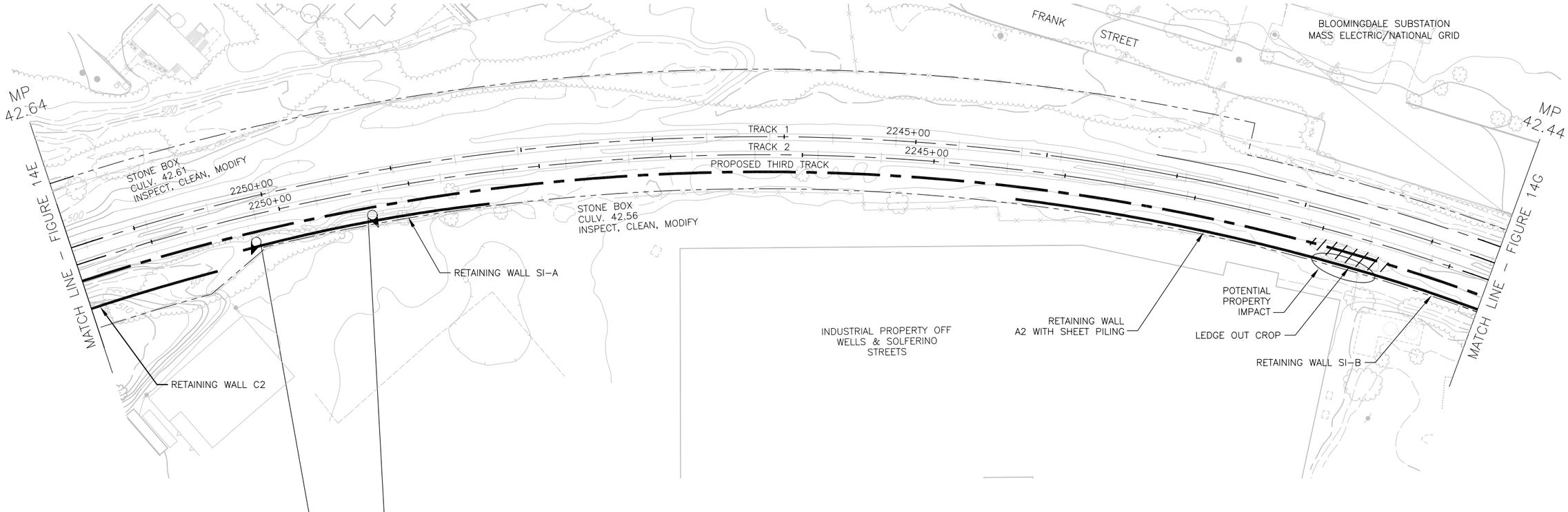
Worcester

FIGURE 14E



VIEWS LOOKING SOUTHWEST FROM TRACK AT INDUSTRIAL BUILDING AT END OF WELLS STREET AND SOUTH AT PARKING LOT AND INDUSTRIAL BUILDING AT END OF SOLFERINO STREET

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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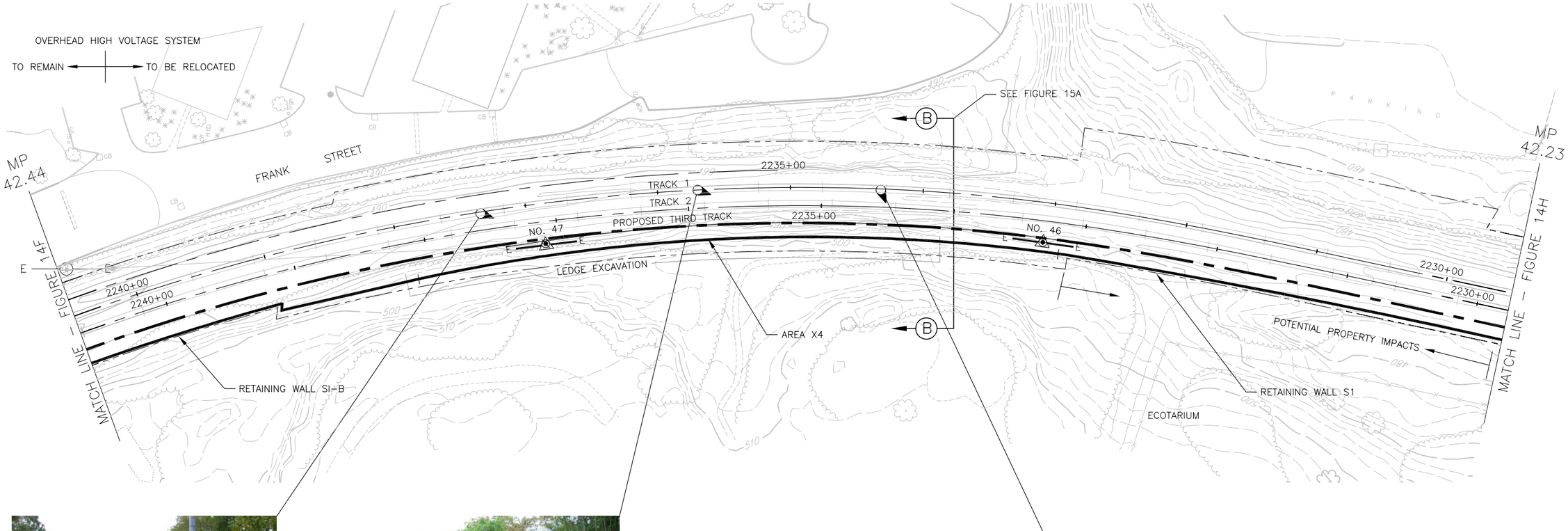
FIGURE 14F

P:\JOBS\39285 Worcester Third Track\TechProd\Cadd\TP14A-14L.dwg, 5/15/2006 1:05:55 PM

OVERHEAD HIGH VOLTAGE SYSTEM

TO REMAIN ◄——► TO BE RELOCATED



VIEW LOOKING SOUTHEAST AT FIRST HIGH VOLTAGE UTILITY POLE OWNED BY NATIONAL GRID

VIEW LOOKING SOUTHEAST AT UTILITY POLE AND LEDGE CUTS REQUIRED

LEDGE AT ADJOINING RESIDENCE/NEW CONSTRUCTION EAST OF MARLBORO/FRANKLIN STREET OFF PAPAGNI CIRCLE

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E —△— E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E —○— E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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FIGURE 14G

OVERHEAD HIGH VOLTAGE SYSTEM
TO BE RELOCATED ◄ ► TO BE RELOCATED

MP 42.23

MATCH LINE – FIGURE 14G

MP 42.02

MATCH LINE – FIGURE 14I

SEE FIGURE 15A

WETLAND A

100' WETLAND BUFFER ZONE

100' WETLAND B BUFFER ZONE

2225+00

2225+00

2220+00

2220+00

TRACK 1

TRACK 2

PROPOSED THIRD TRACK

NO. 45

NO. 44

NO. 43

E E

STONE BOX CULV. 42.15 INSPECT, CLEAN, MODIFY

RETAINING WALL A3 WITH SHEET PILING

AREA X5

RETAINING WALL S2

APPROXIMATE 100' WETLAND BUFFER ZONE

POTENTIAL PROPERTY ISSUES THIS ENTIRE SHEET

RETAINING WALL S1

ECOTARIUM

POND 1

VIEW LOOKING WEST AT UTILITY POLE

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

HNTB

Worcester Commuter Rail Service Improvements
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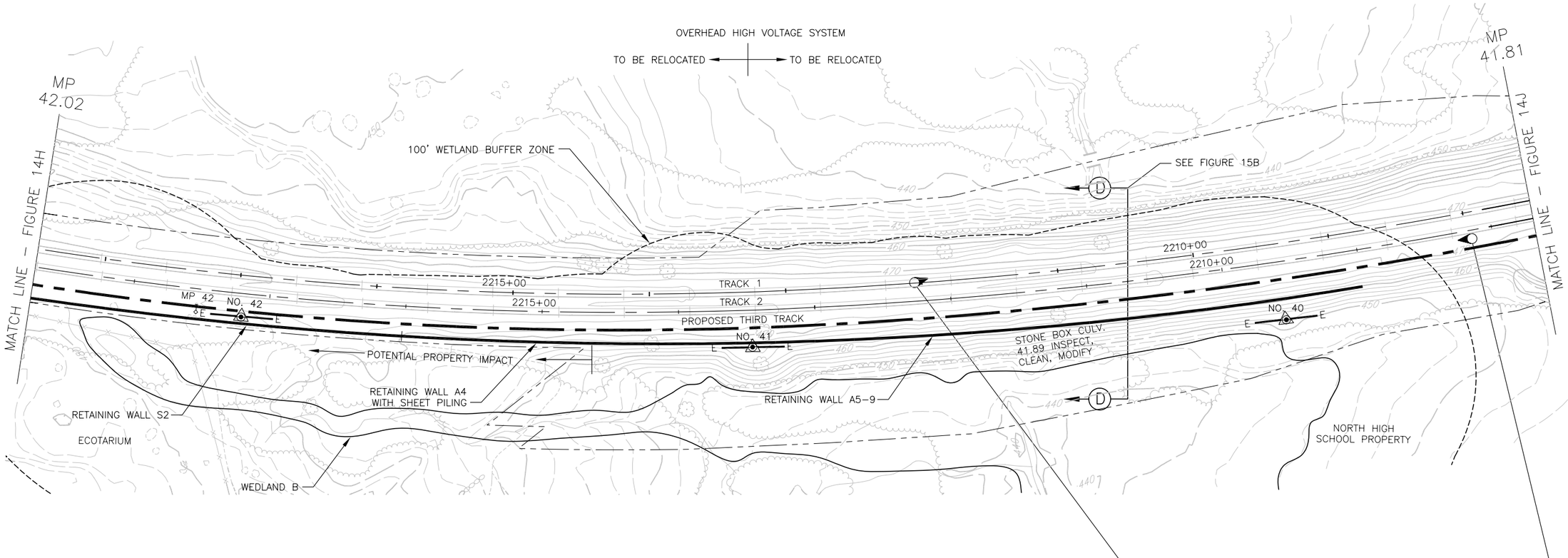
Worcester

FIGURE 14H

P:\JOBS\39285 Worcester Third Track\TechProd\Cadd\TP14A-14L.dwg, 5/15/2006 1:26:12 PM



VIEW LOOKING SOUTH AT UTILITY POLE NO. 40

VIEW LOOKING NORTH AT UTILITY POLE NO. 40

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

HNTB

Worcester Commuter Rail Service Improvements

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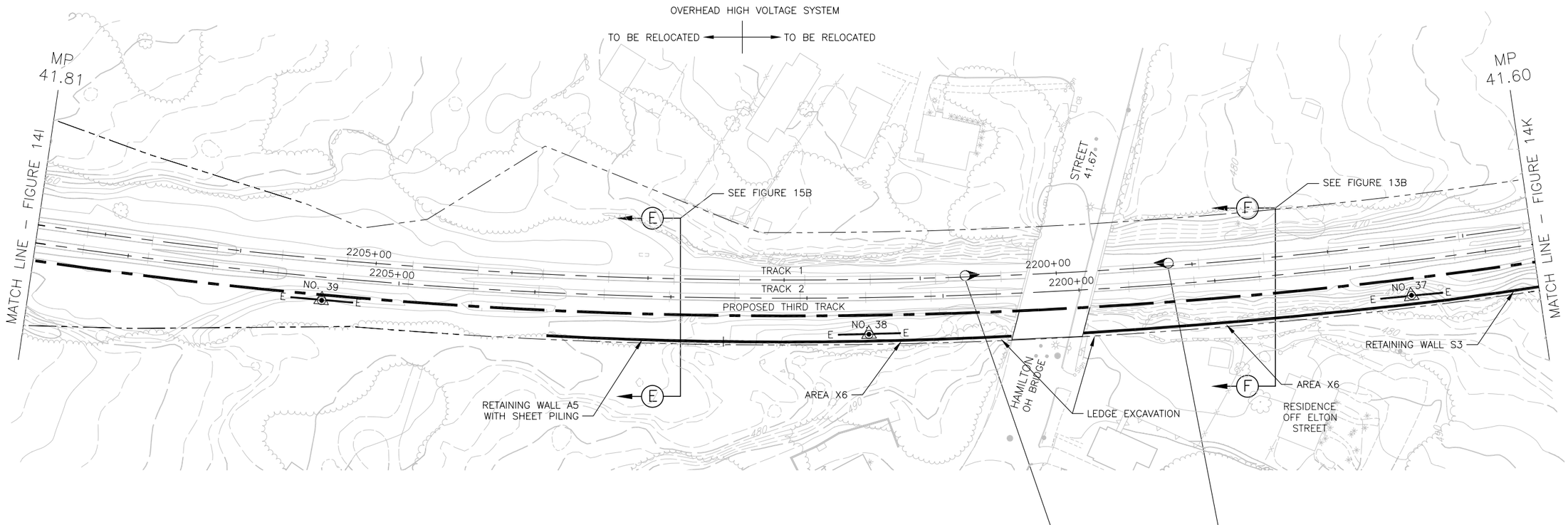
Worcester

FIGURE 14I



LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — △ — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — ○ — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

HNTB

HAMILTON STREET OVER RR (MP 41.67)

THIS IS A SINGLE–SPAN BUTTED–BOX CONCRETE BRIDGE. IN ORDER TO ACCOMMODATE THE PROPOSED TRACK, THIS BRIDGE WILL REQUIRE LENGTHENING OF SUPERSTRUCTURE AND SOUTH ABUTMENT RELOCATION. STAGED CONSTRUCTION WILL BE REQUIRED.
UTILITIES: 8" & 12" GAS LINES, 12" WATER.

UNDERSIDE OF HAMILTON BRIDGE STREET. POSSIBLY SHIFT TRACK TO EAST TO AVOID BRIDGE IMPACTS

Worcester Commuter Rail Service Improvements
Conceptual Design Report

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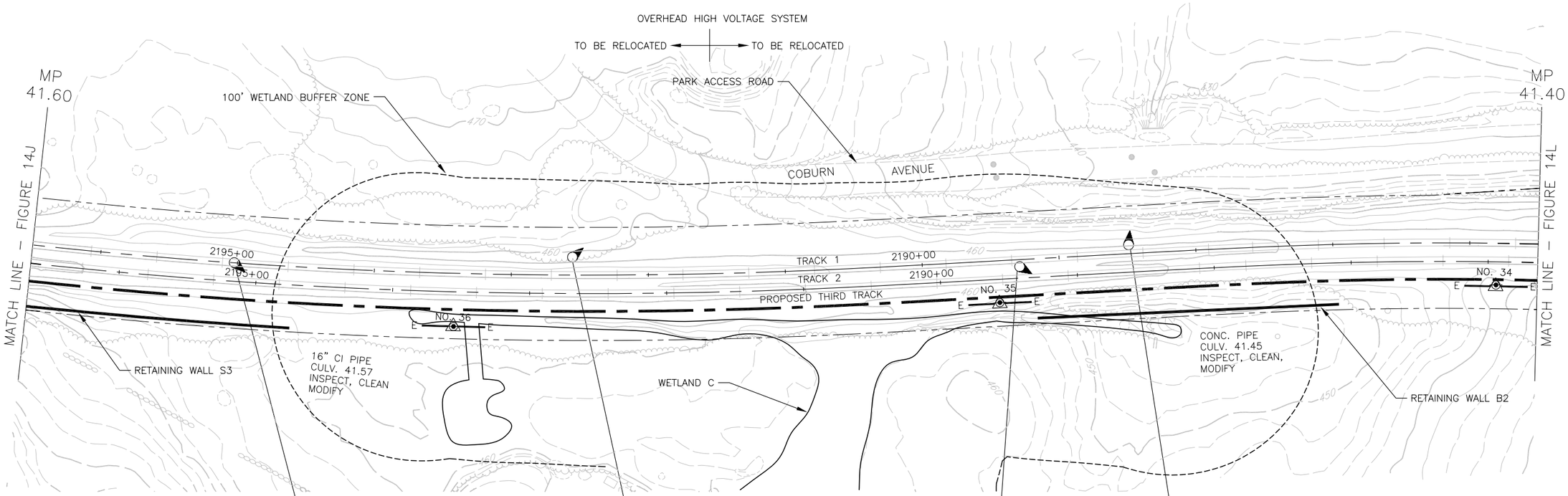
Worcester

FIGURE 14J



LOOKING SOUTH AT MARKING FOR CULVERT 41.57 AND UTILITY POLE

LOOKING EAST AT LAKE PARK

LOW LYING AREA ADJOINING CULVERT 41.45

LAKE PARK–75.6 ACRE MUNICIPAL PARK

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

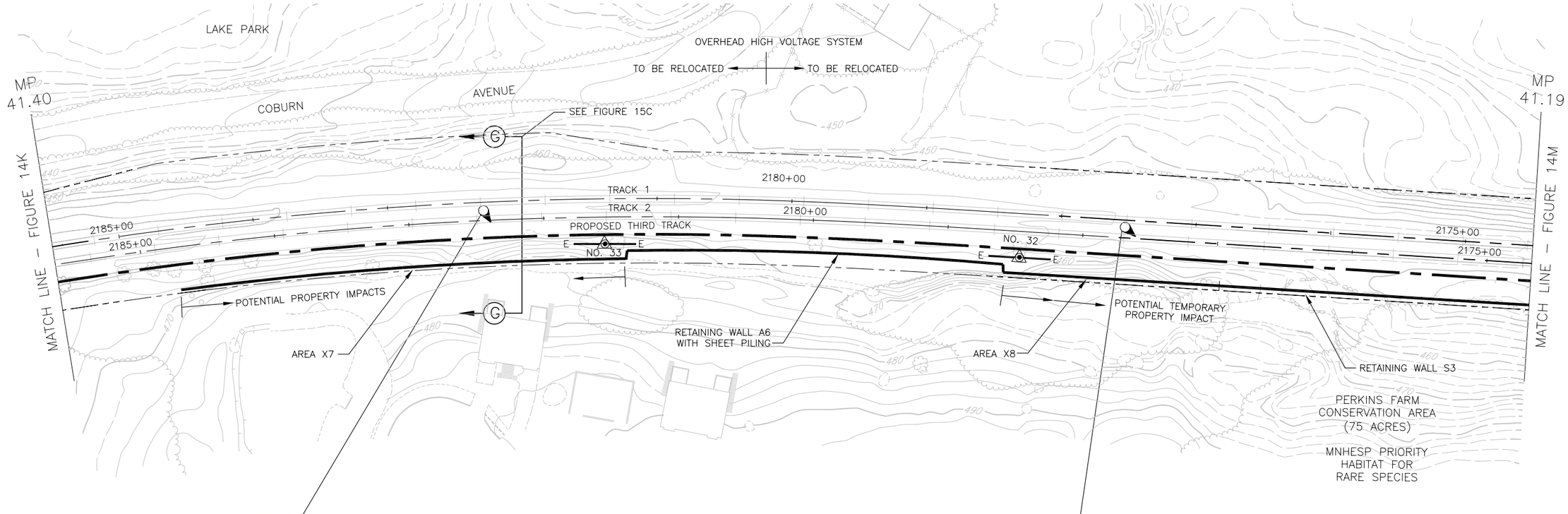
HNTB

Worcester Commuter Rail Service Improvements

Conceptual Design Report

Track Plan
Worcester

FIGURE 14K



RESIDENTIAL UNITS AT ORTON
STREET EXTENSION

PERKINS FARM CONSERVATION AREA ON RIGHT

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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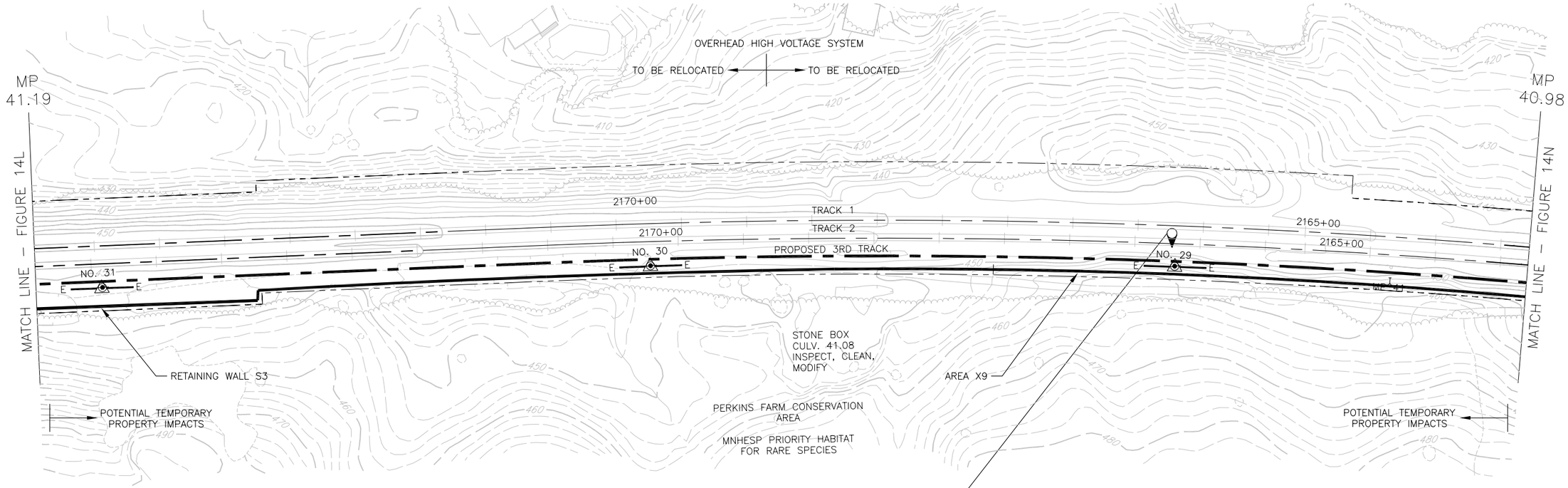
Track Plan
Worcester

FIGURE 14L

P:\JOBS\39285 Worcester Third Track\TechProd\Cadd\TP14A-14L.dwg, 5/15/2006 2:04:35 PM



UTILITY POLE NO. 29 UNDERMINED

PARK ENTRANCE OFF ROUTE 122

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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Worcester Commuter Rail Service Improvements
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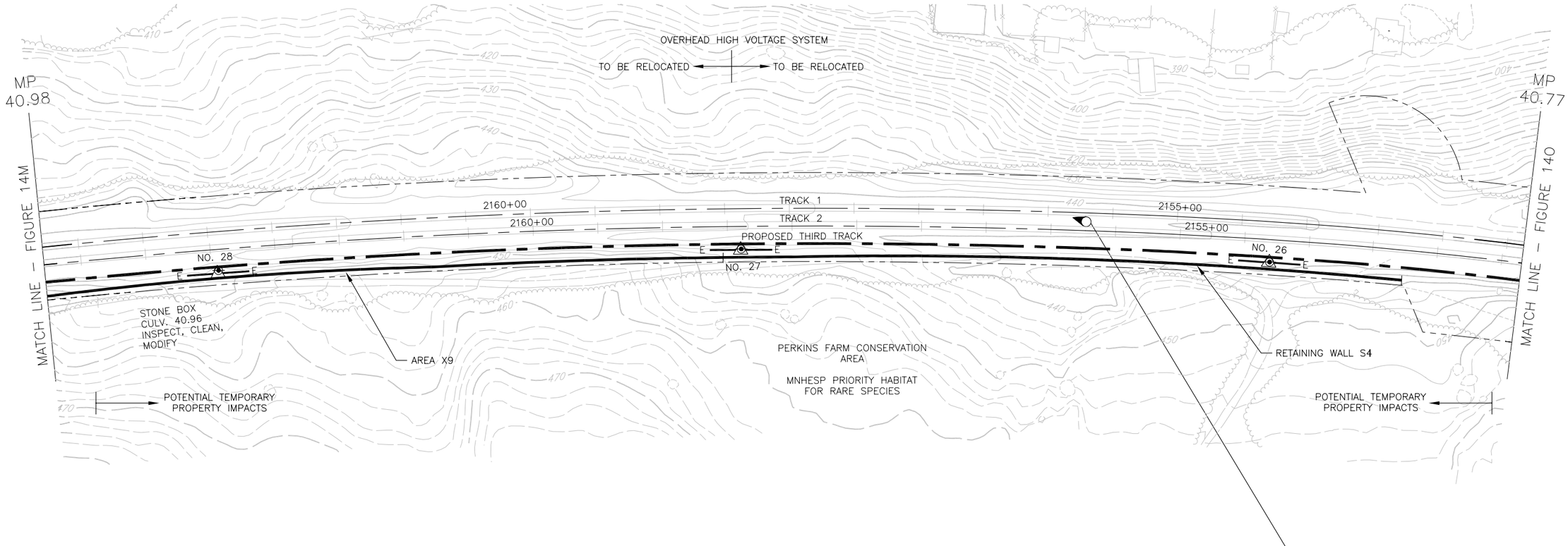
Worcester

FIGURE 14M



LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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Worcester Commuter Rail Service Improvements
Conceptual Design Report

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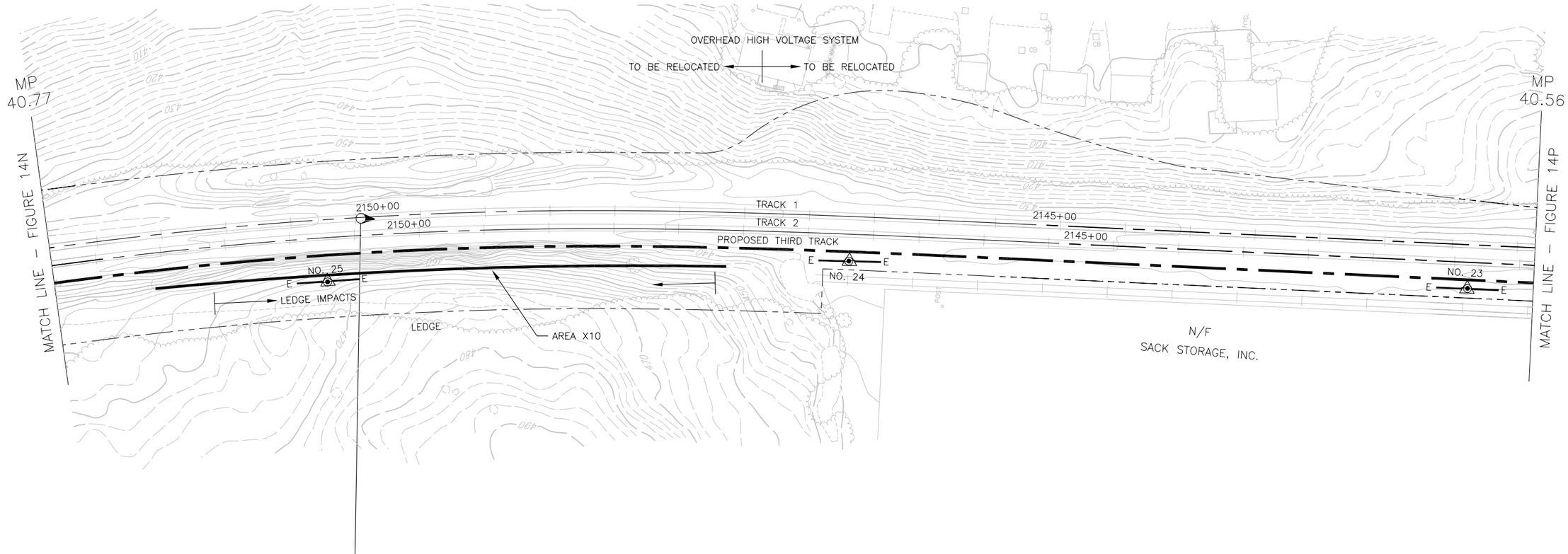
Worcester

FIGURE 14N

P:\JOBS\39285 Worcester Third Track\TechProd\Cadd\TP14M-14R.dwg, 5/15/2006 2:21:56 PM



AREA OF LEDGE IMPACTS

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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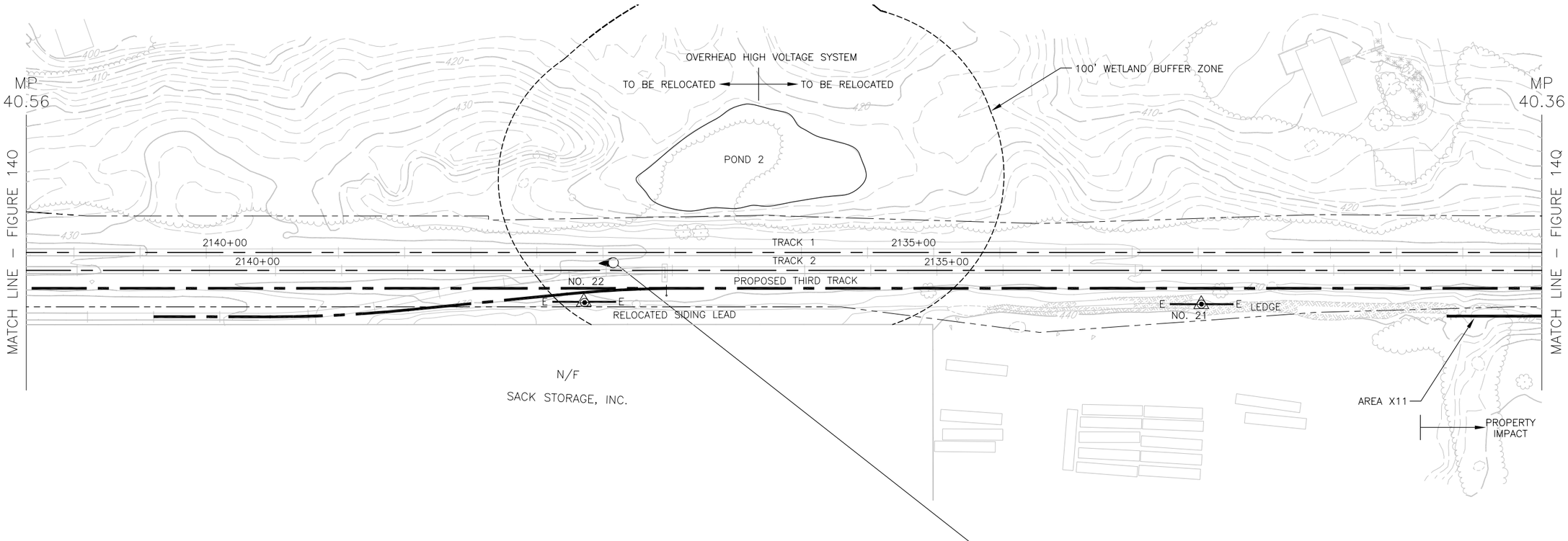
FIGURE 140



SACK SIDING

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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Worcester Commuter Rail Service Improvements

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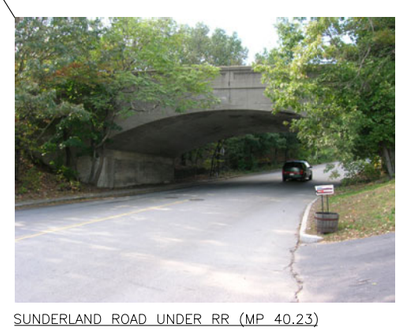
Worcester

FIGURE 14P



SUNDERLAND ROAD UNDER RR (MP 40.23)

THIS IS A SINGLE–SPAN CONCRETE ARCH BRIDGE WITH LOW VERTICAL CLEARANCE (10'6" TO 12'10"). INSTALLATION OF PROPOSED TRACK WILL REQUIRE WIDENING (12–FEET) OF THIS BRIDGE. FOR AESTHETIC REASONS THE NEW STRUCTURE WOULD HAVE TO MATCH EXISTING.

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — HIGH VOLTAGE ELECTIC POLE–RELOCATE — E
- E — HIGH VOLTAGE ELECTIC POLE–RETAIN — E
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

HNTB

Worcester Commuter Rail Service Improvements
Conceptual Design Report

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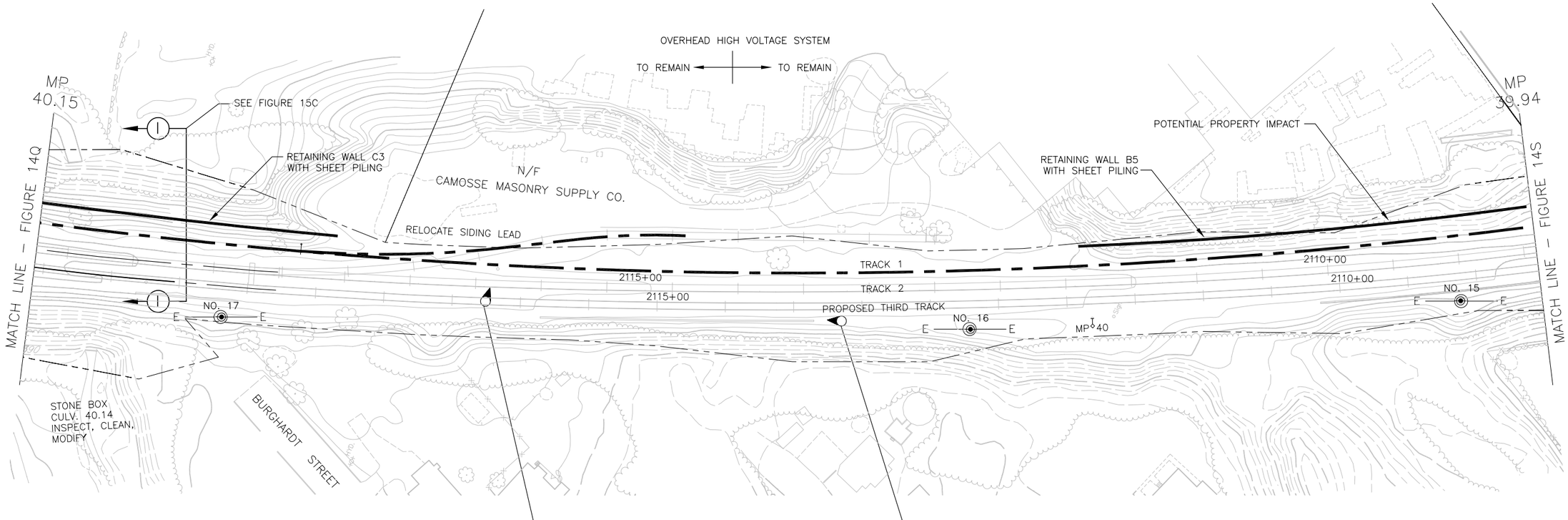
Worcester

FIGURE 14Q



CSX CREW REPLACING CWR

EXISTING BALLAST RETAINING WALL

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

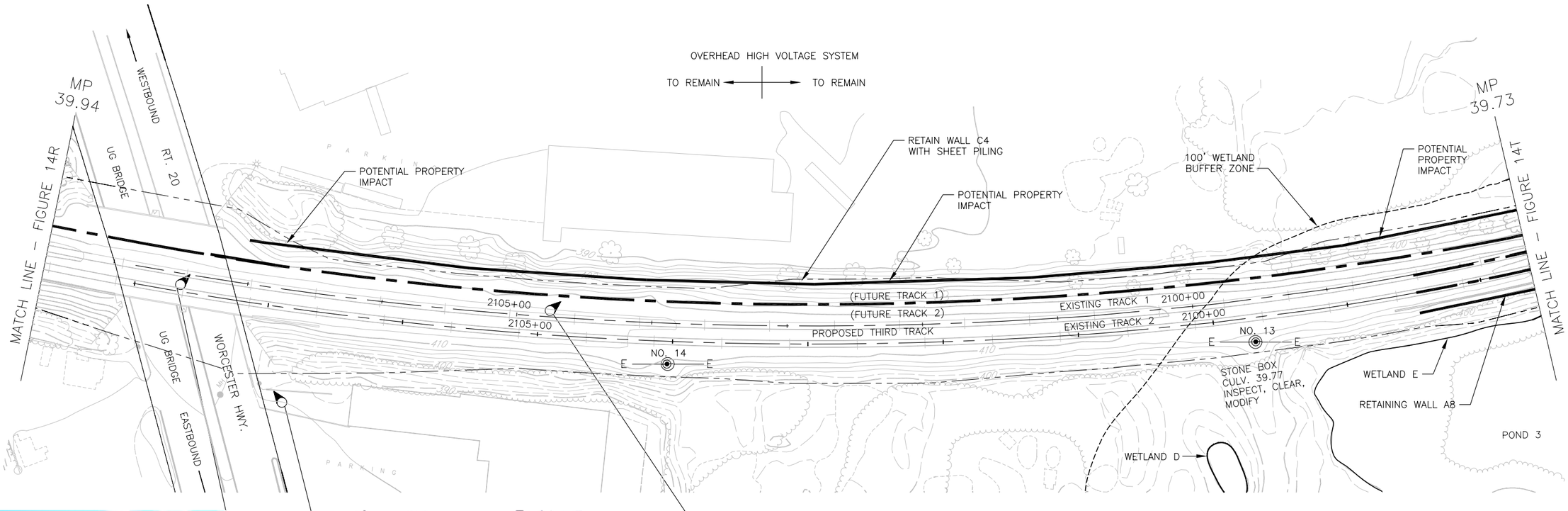
HNTB

Worcester Commuter Rail Service Improvements
Conceptual Design Report

Track Plan
Worcester

FIGURE 14R

P:\JOBS\39285 Worcester Third Track\TechProd\Cadd\TP14M-14R.dwg, 5/16/2006 5:27:20 AM



ROUTE 20 BRIDGE

ROUTE 20 UNDER RR (MP 39.94)

THIS IS A 2–SPAN RIVETED STEEL PLATE GIRDER BRIDGE WITH CONCRETE DECK. THE BRIDGE CAN ACCOMMODATE PROPOSED TRACK SINCE IT WAS ORIGINALLY DESIGNED FOR FOUR TRACKS.

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

HNTB

Worcester Commuter Rail Service Improvements
Conceptual Design Report

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Worcester

FIGURE 14S

P:\JOBS\39285 Worcester Third Track\TechProd\Cadd\TP14S-14X.dwg, 5/16/2006 5:42:10 AM

MP 39.73

MATCH LINE – FIGURE 14S

OVERHEAD HIGH VOLTAGE SYSTEM
TO REMAIN ◄ ► TO BE RELOCATED

FIBER OPTIC CONDUIT
PROTECT OR RELOCATE
AS NECESSARY

100' WETLAND BUFFER ZONE

TRACK LINED OVER
FOR ROUTE 20 BRIDGE

2095+00

2095+00

NO. 12

E E

WETLAND E

POND 3

RETAINING WALL S4

RETAINING WALL A8

100' WETLAND BUFFER ZONE

TRACK 1

TRACK 2

PROPOSED THIRD TRACK

2090+00

2090+00

NO. 11

E E

WETLAND F

WORCESTER

MILLBURY

J

J

SEE FIGURE 15C

RETAINING WALL B5–A

RETAINING WALL AB–A

NO. 10

E E

MATCH LINE – FIGURE 14U

MP 39.52

EXISTING BALLAST RETAINING WALL WITH POND IN THE BACK GROUND

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

HNTB

Worcester Commuter Rail
Service Improvements
Conceptual Design Report

Track Plan
Worcester-Millbury

FIGURE 14T

MP 39.52

MATCH LINE – FIGURE 14T

OVERHEAD HIGH VOLTAGE SYSTEM

TO BE RELOCATED ← → TO BE RELOCATED

100' WETLAND BUFFER ZONE

100' WETLAND BUFFER ZONE

2085+00

2085+00

TRACK 1

TRACK 2

PROPOSED THIRD TRACK

2080+00

2080+00

E E NO. 9

E E NO. 8

WETLAND G

RETAINING WALL S5

RETAINING WALL A8–9

100' WETLAND BUFFER ZONE

WETLAND H

WETLAND I

100' WETLAND BUFFER ZONE

RETAINING WALL S6

WETLAND J

MP 39.32

MATCH LINE – FIGURE 14V

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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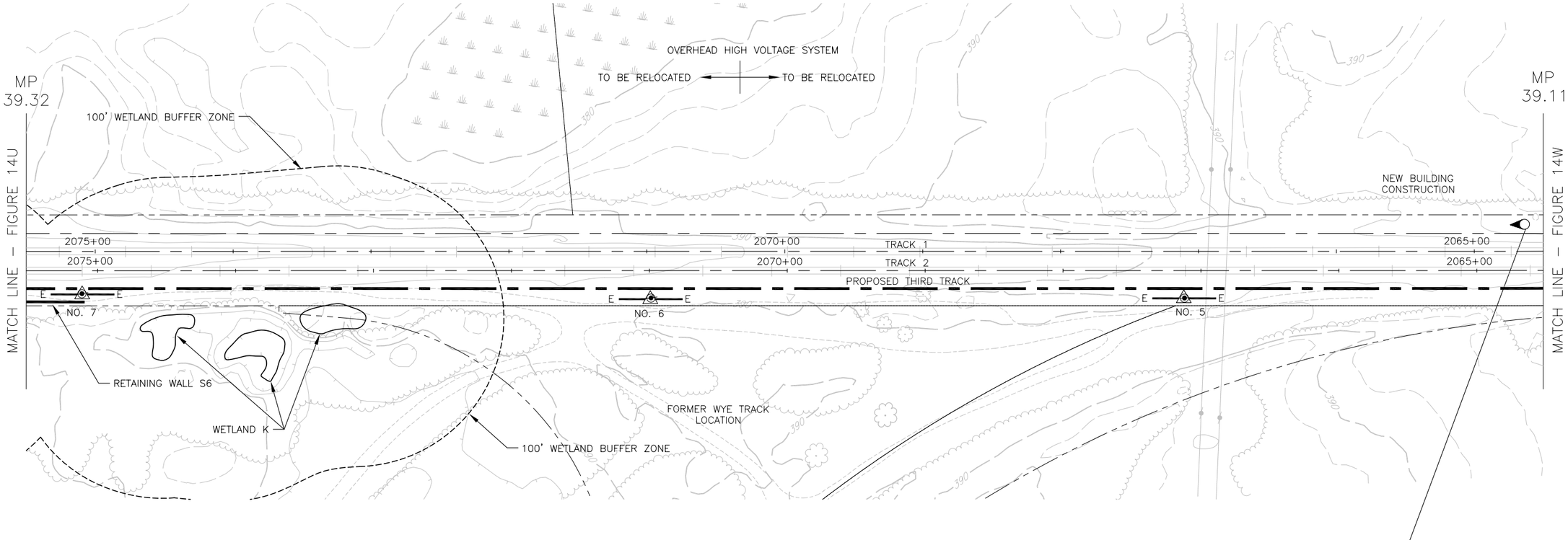
Worcester Commuter Rail Service Improvements

Conceptual Design Report

Track Plan
Millbury

FIGURE 14U

P:\JOBS\39285 Worcester Third Track\TechProd\Cadd\TP14S-14X.dwg, 5/16/2006 6:03:11 AM



NEW BUILDING CONSTRUCTION

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

HNTB

Worcester Commuter Rail Service Improvements

Conceptual Design Report

Track Plan
Millbury

FIGURE 14V

MP 39.11

MATCH LINE – FIGURE 14V

GRAFTON

MILLBURY

OVERHEAD HIGH VOLTAGE SYSTEM

TO BE RELOCATED ← → TO REMAIN

MP 38.90

MATCH LINE – FIGURE 14X

100' WETLAND BUFFER ZONE

CP39

2060+00

2060+00

TRACK 1

TRACK 2

2055+00

2055+00

NO. 4

NO. 3

PROPOSED THIRD TRACK

MP 39

E E

E E

E E

E E

100' WETLAND BUFFER ZONE

RETAINING WALL B6 WITH SHEET PILING

RETAINING WALL A9 WITH SHEET PILING

RETAINING WALL B7 WITH SHEET PILING

WETLAND L

WETLAND N

WETLAND M

CP 39 HIGH VOLTAGE POWER LINES OVERHEAD

LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

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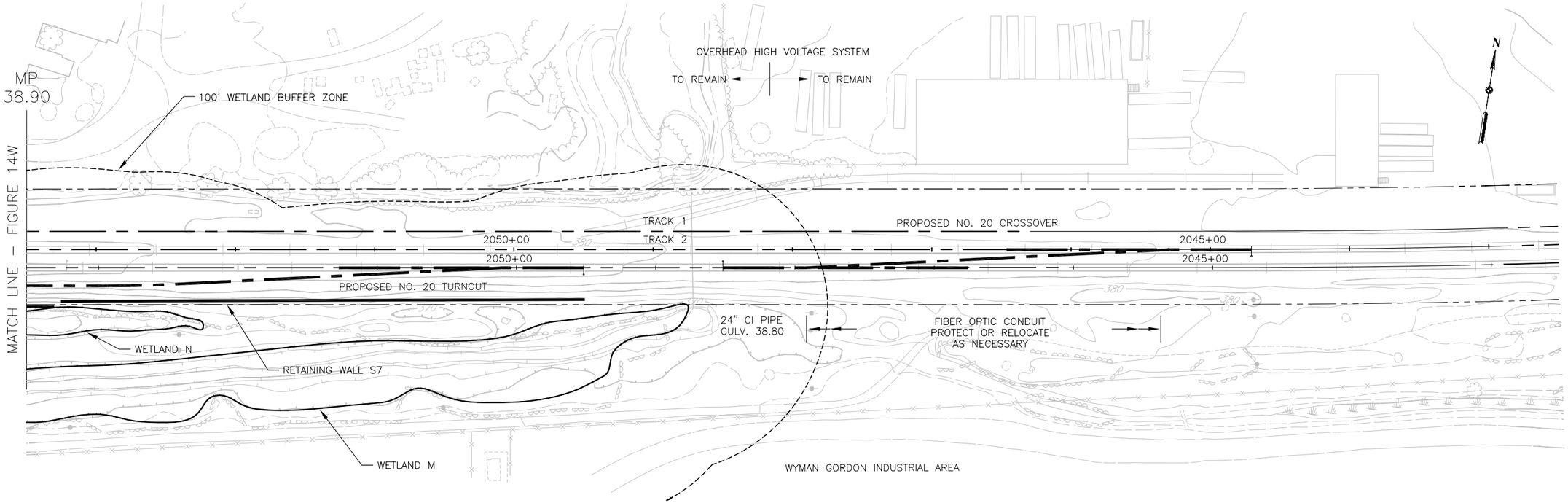
Worcester Commuter Rail Service Improvements

Conceptual Design Report

Track Plan
Millbury-Grafton

FIGURE 14W

P:\JOBS\39285 Worcester Third Track\TechProd\Cadd\TP14S-14X.dwg, 5/16/2006 6:16:41 AM



LEGEND

- APPROXIMATE RIGHT OF WAY LINE
- PROPOSED TRACK
- E — E HIGH VOLTAGE ELECTIC POLE–RELOCATE
- E — E HIGH VOLTAGE ELECTIC POLE–RETAIN
- 200' RIVERFRONT PROTECTION AREA
- WETLAND BUFFER
- INDICATED LOCATION AND DIRECTION OF PHOTO
- NATIONAL GRID HIGH VOLTAGE POWER POLE

0 40 80 120 160 FEET

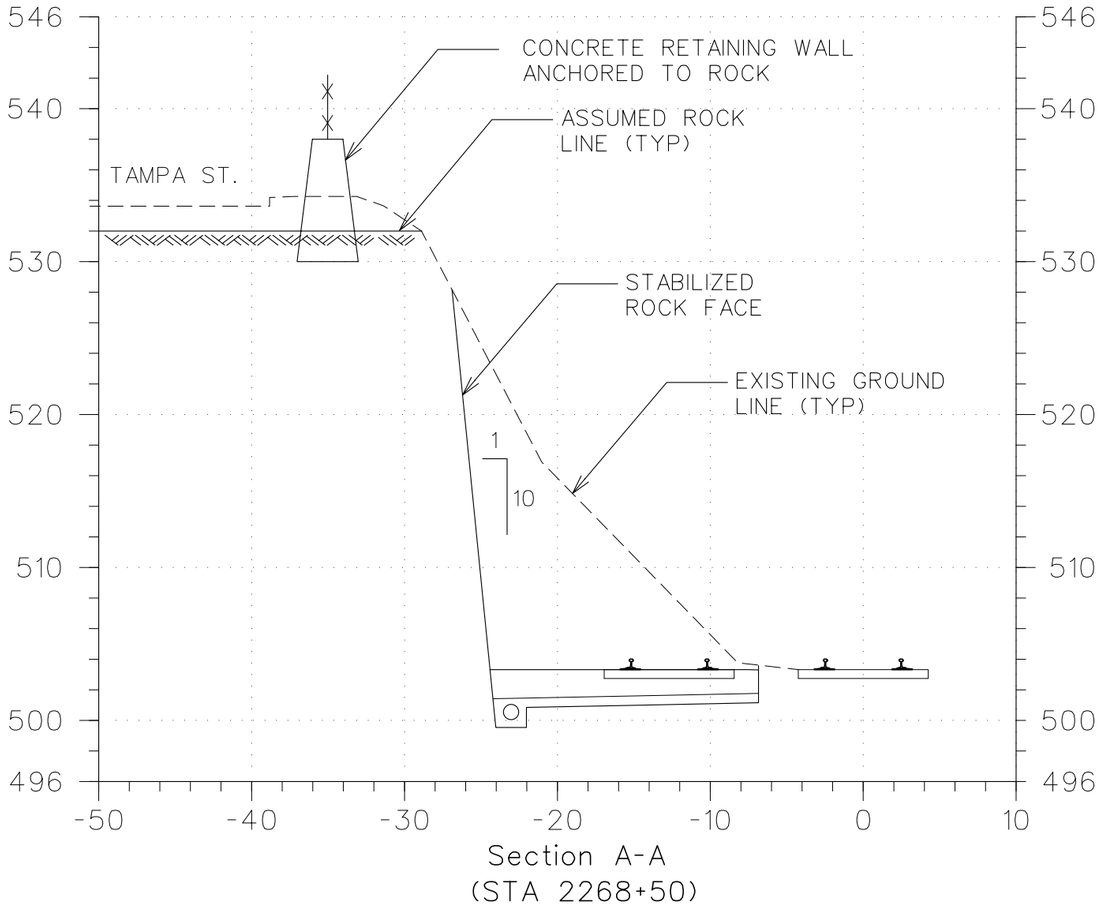
HNTB

Worcester Commuter Rail
Service Improvements
Conceptual Design Report

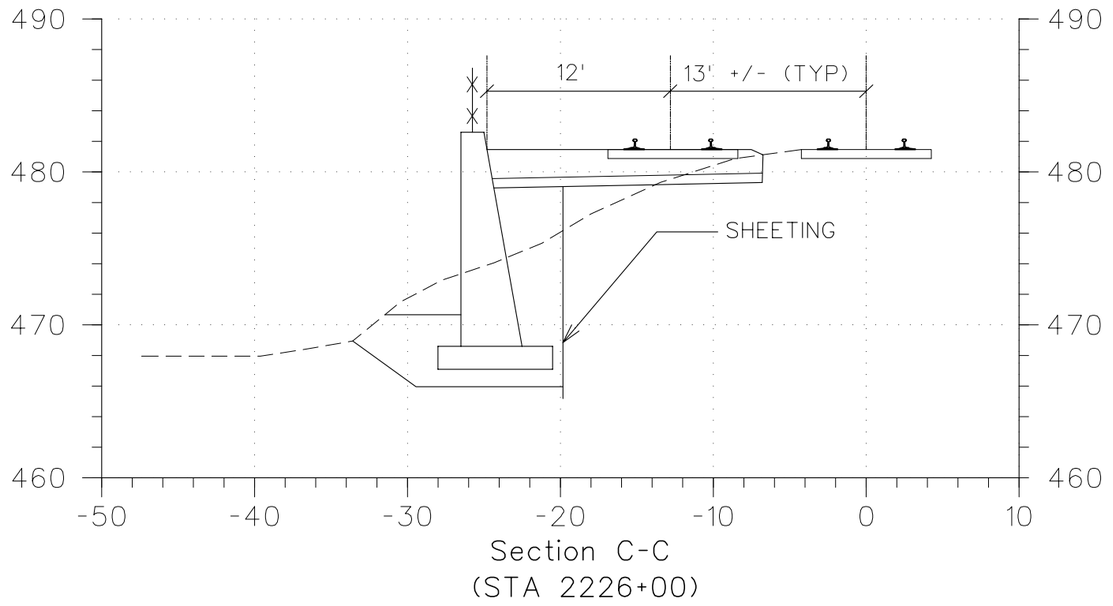
Track Plan
Grafton

FIGURE 14X

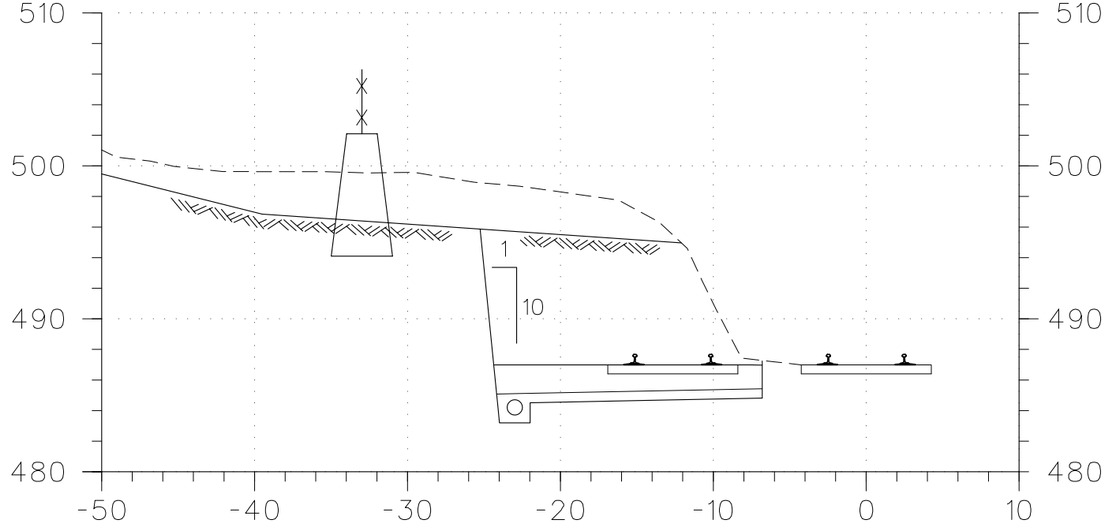
P:\JOBS\39285 Worcester Third Track\TechProd\Cadd\TP14S-14X.dwg, 5/16/2006 6:25:12 AM



Section A-A
(STA 2268+50)



Section C-C
(STA 2226+00)



Section B-B
(STA 2234+00)

5' 0' 5' 10'
SCALE: 1" = 5'

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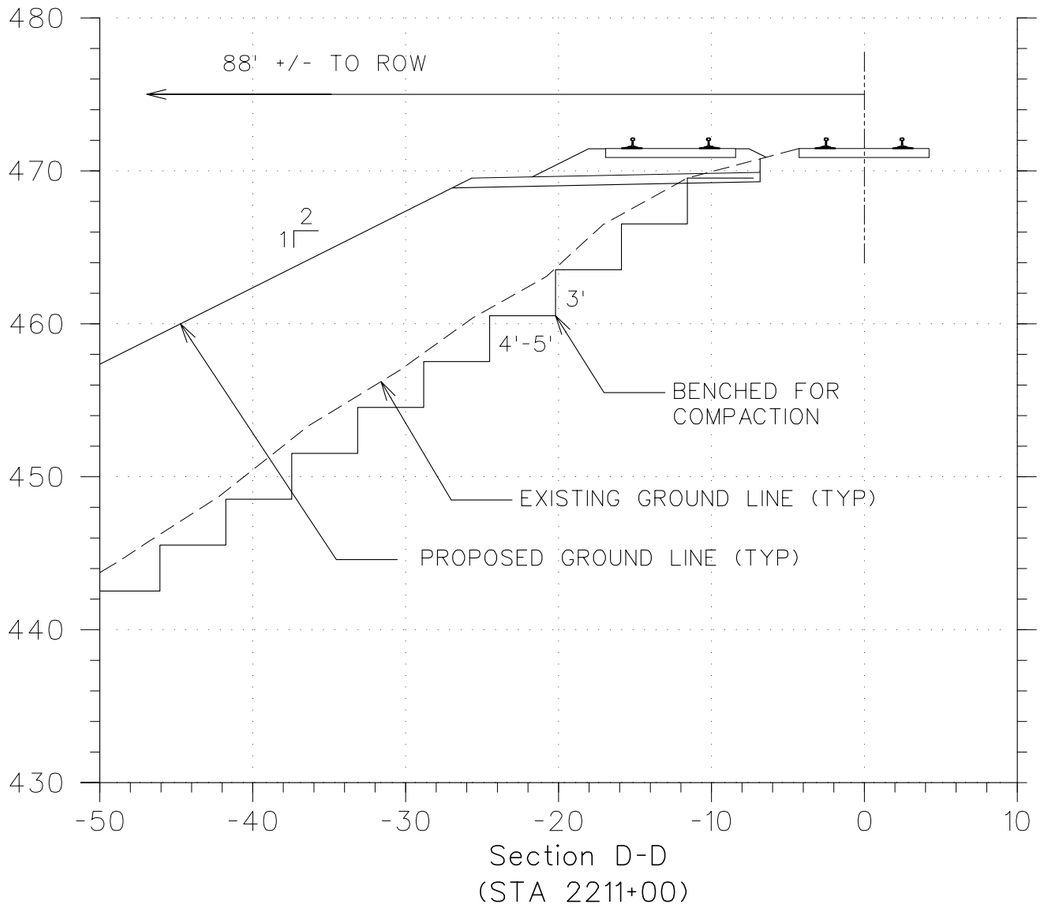
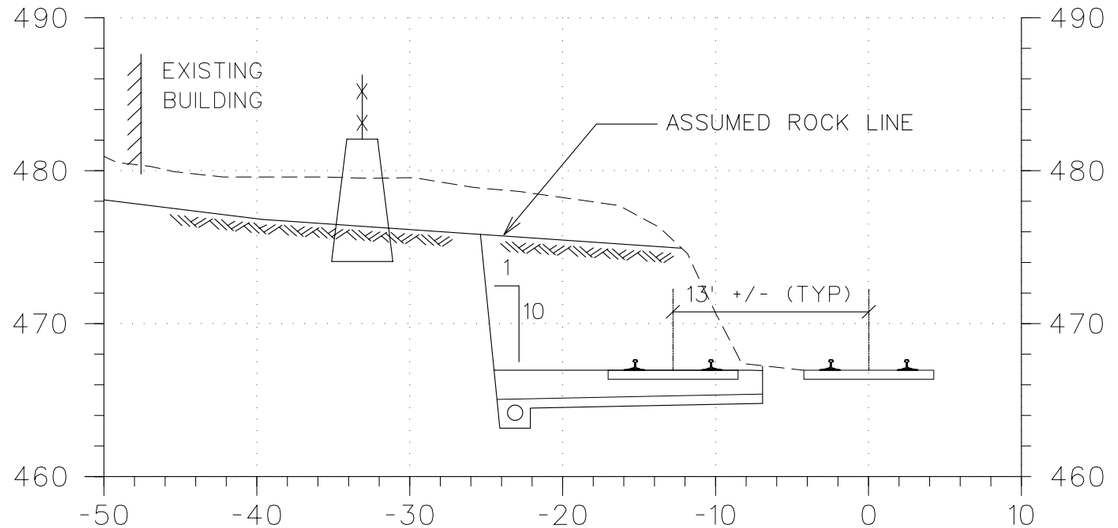
Worcester Commuter Rail Service Improvements
Conceptual Design Report

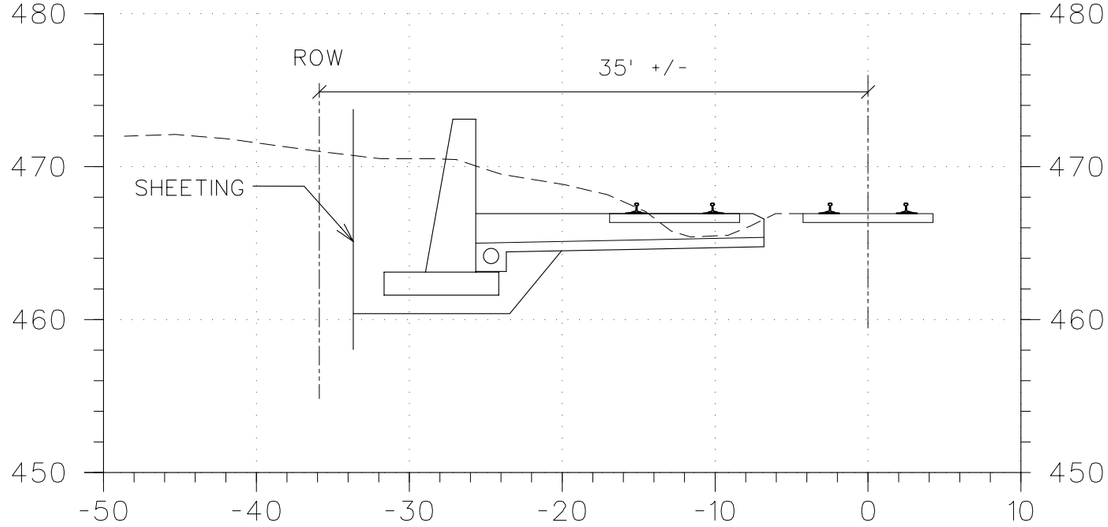
Cross Sections
Worcester-Millbury
Grafton
FIGURE 15A



Section D-D
(STA 2211+00)



Section F-F
(STA 2199+00)



Section E-E
(STA 2203+00)

5' 0' 5' 10'
SCALE: 1" = 5'

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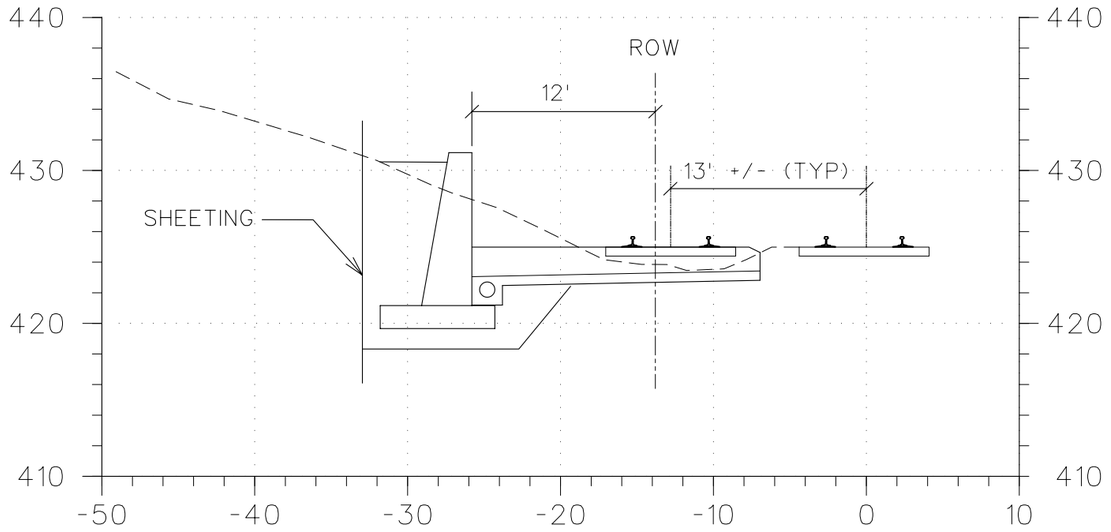
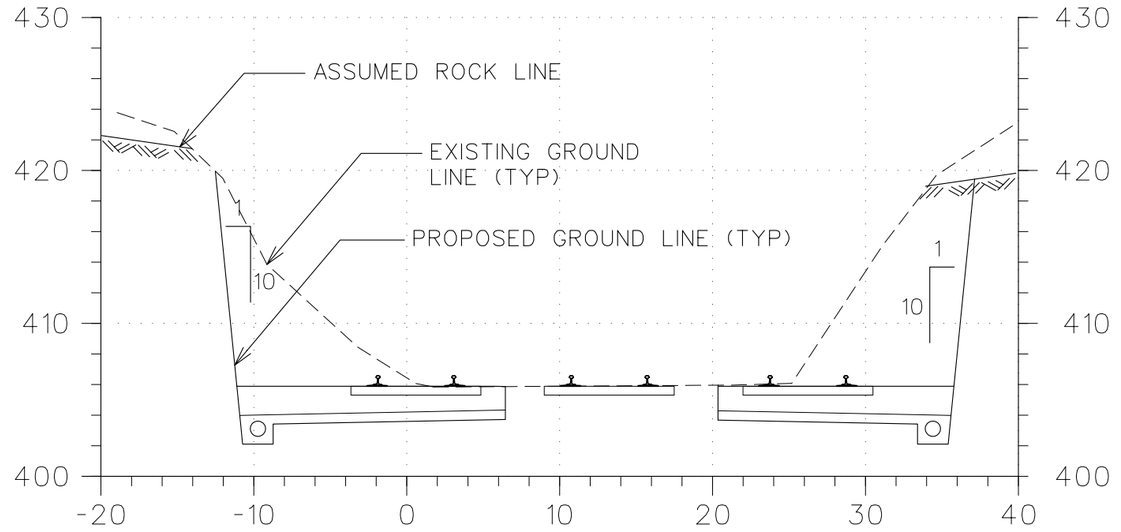
Worcester Commuter Rail Service Improvements
Conceptual Design Report

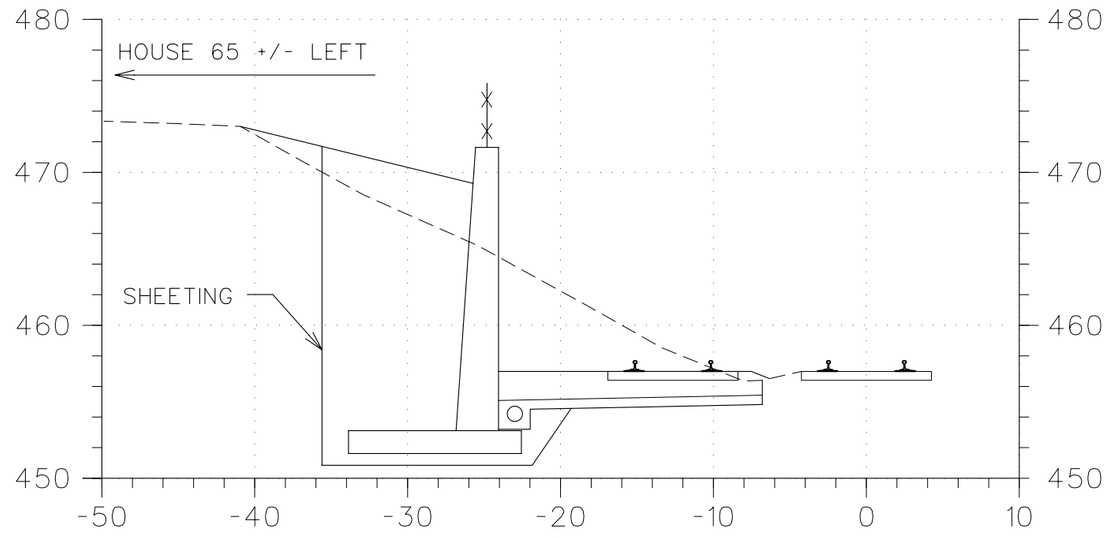
Cross Sections
Worcester-Millbury
Grafton
FIGURE 15B



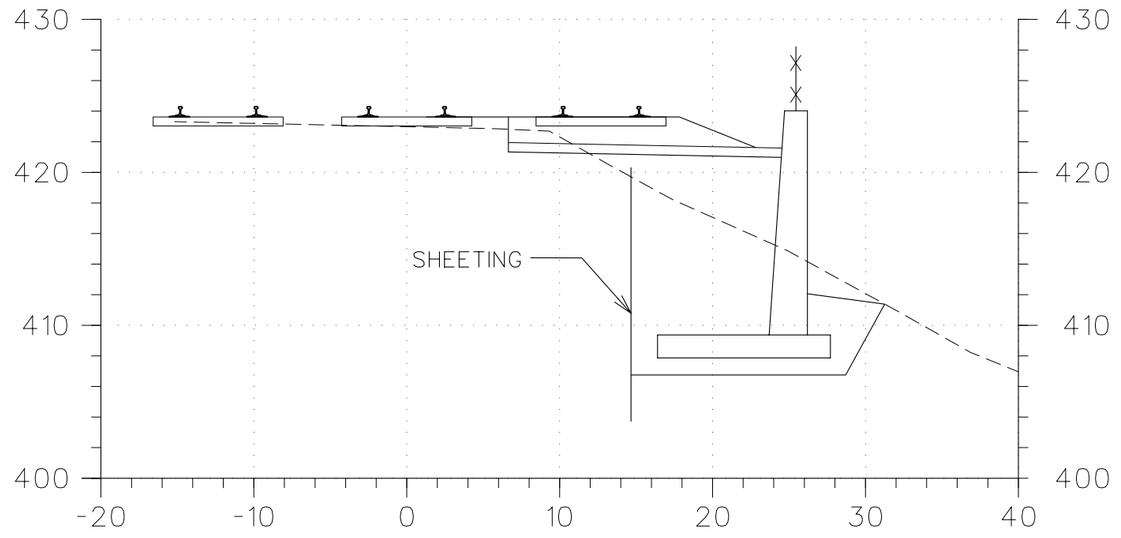
Section H-H
(STA 2128+50)



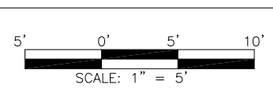
Section J-J
(STA 2090+00)



Section G-G
(STA 2182+00)



Section I-I
(STA 2118+50)



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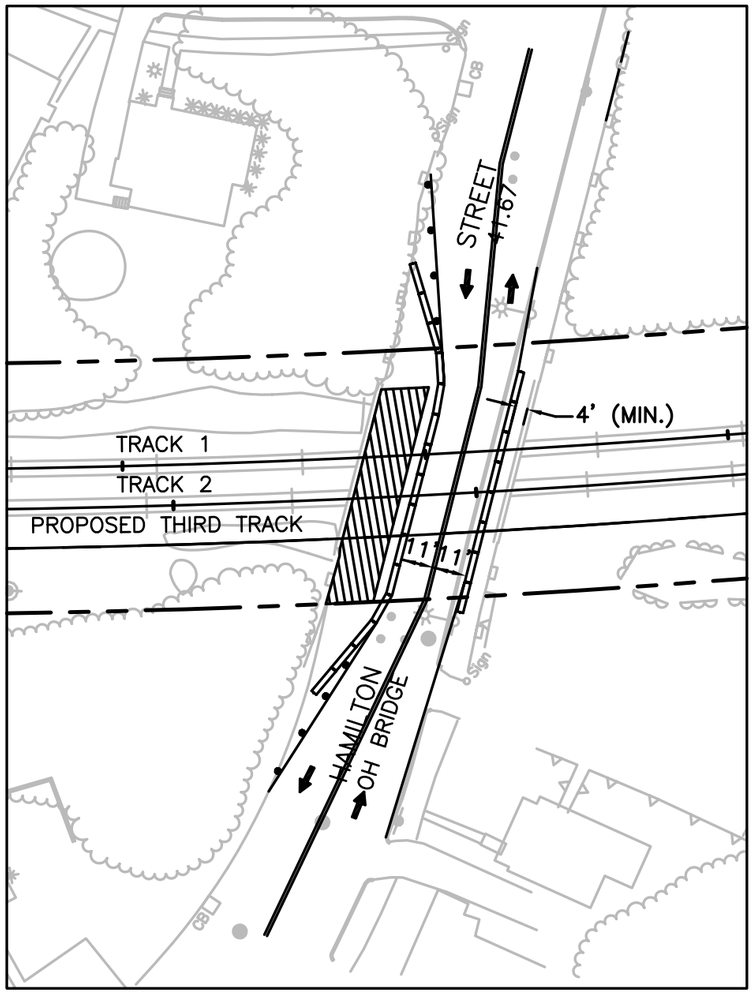
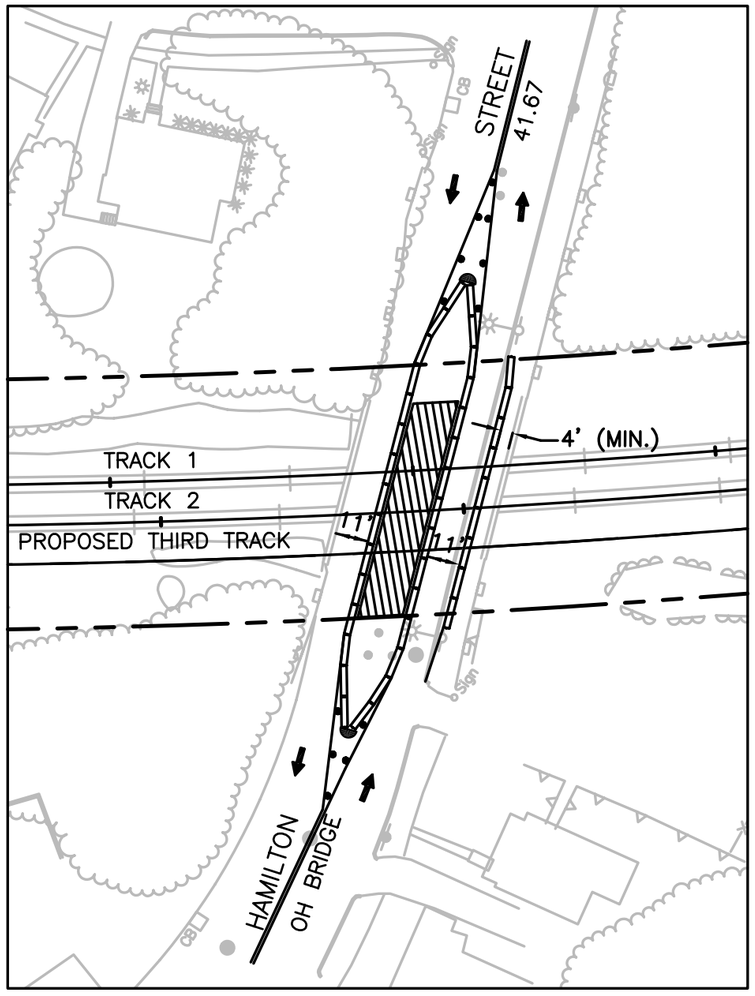
Worcester Commuter Rail Service Improvements
Conceptual Design Report

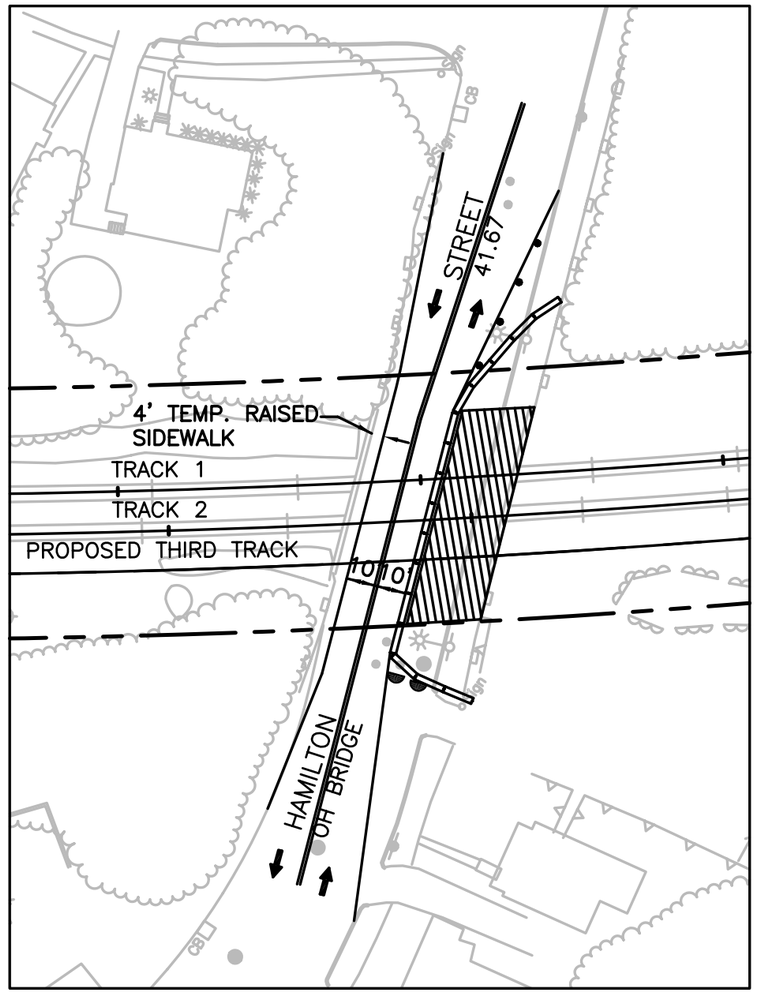
Cross Sections
Worcester-Millbury
Grafton
FIGURE 15C



CONSTRUCTION STAGE I



CONSTRUCTION STAGE II



CONSTRUCTION STAGE III

LEGEND

- TEMP. MEDIAN BARRIER
- DRUMS
- TERM. IMPACT ATTENUATOR
- TEMP. DOUBLE YELLOW SOLID LINES
- PROP. WORK AREA

0 50 100 FEET

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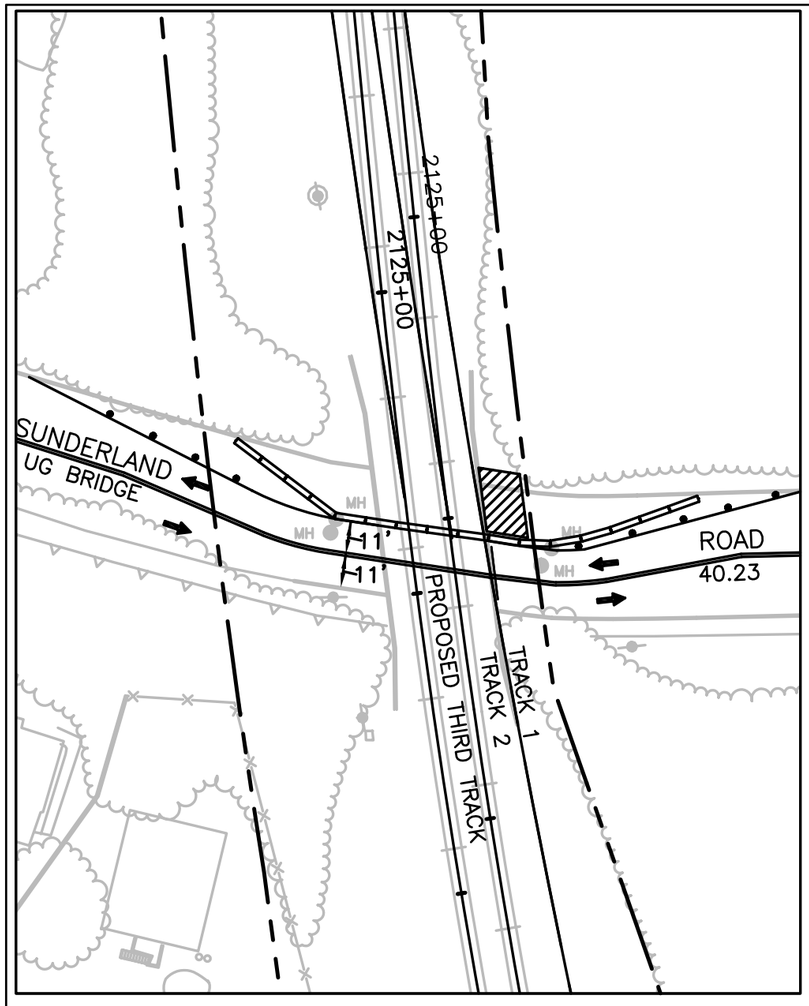
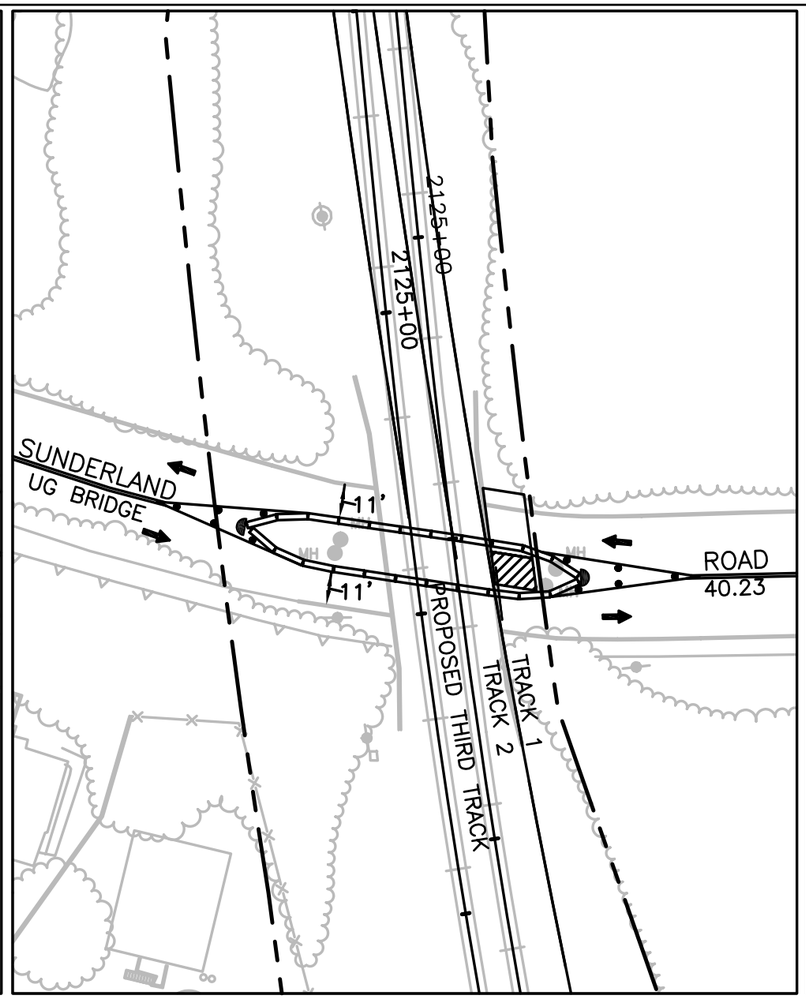
Worcester Commuter Rail
Service Improvements
Conceptual Design Report

Hamilton Street
Traffic Management
Plan
Figure 16a

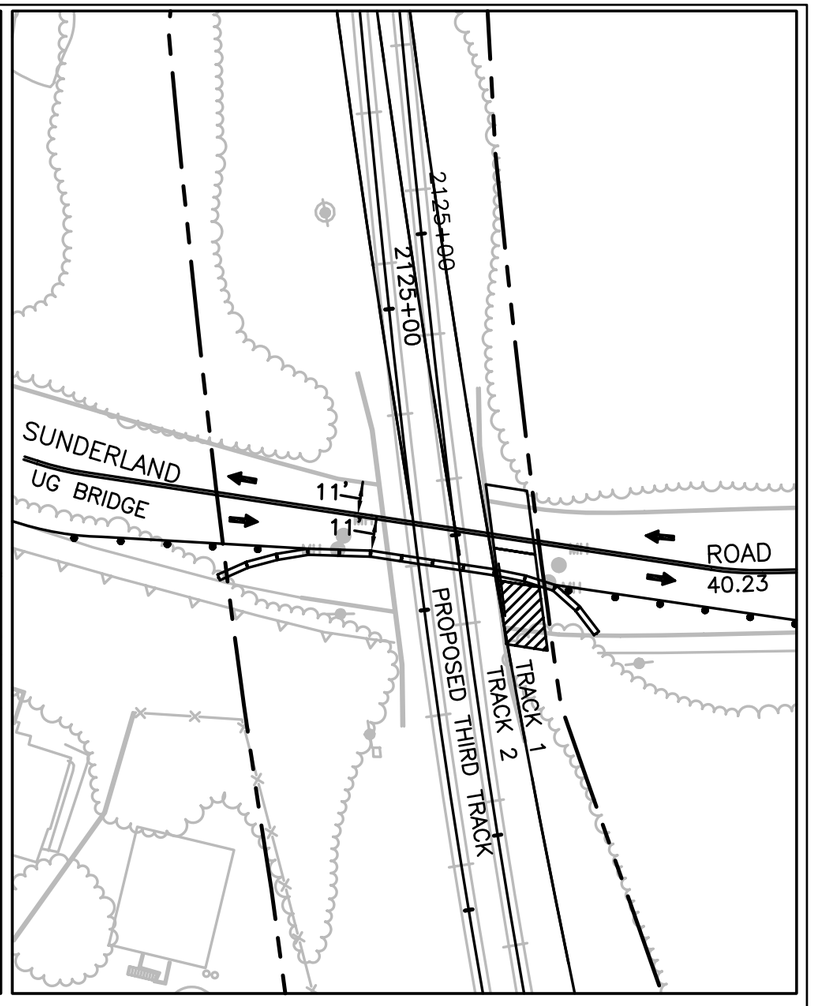
M:\39285-WORCESTER\GREEN 11-3-05\NEW DWGS\HAMILTON.DWG 11/11/05 13:46



CONSTRUCTION STAGE I



CONSTRUCTION STAGE II



CONSTRUCTION STAGE III

LEGEND

- TEMP. MEDIAN BARRIER
- DRUMS
- TERM. IMPACT ATTENUATOR
- TEMP. DOUBLE YELLOW SOLID LINES
- PROP. WORK AREA

0 50 100 FEET

HNTB

Worcester Commuter Rail
Service Improvements
Conceptual Design Report

SunderlandRoad
Traffic Management
Plan
Figure 16b

M:\39285-WORCESTER\GREEN 11-3-05\NEW DWGS\SUNDERLAND.DWG 11/11/05 13:48

Table A-1

Initial Issues Screening

Location			Existing r-o-w / structure	City or	Preferred side of r-o-w	Potential Impacts / Remarks
Mileage	Name	Description	will support 3 Tracks	Town lines	to construct 3rd track	
	Nevins Yard	Freight Yard	4 Existing			May require rehabilitation of existing 3rd iron
22.35	Winter Street	OH Bridge	4 Existing	Framingham		May require rehabilitation of existing 3rd iron
22.9	CP23	Control Point		Ashland	North	Requires r-o-w line swing to south side access road, Sudbury River on north side
22.54	Sudbury River	UG Bridge	Y		South	Existing open access road on south side
23.67	Fountain Street	OH Bridge	Y		South	Existing open access road on south side
23.83	Sudbury River	UG Bridge	Y		South	Existing open access road on south side
24.23	Main Street	Grade Crossing	?		North	Requires new grade crossing and relocation of protection equipment
24.40	Cherry Street	Grade Crossing	?		South	Requires new grade crossing and relocation of protection equipment
24.6	CP24	Control Point				May warrant tying CP into new freight track
25.2	Ashland Station	Station	N			Inpacts to platform, parking and HCP access ramps
25.25	High Street	OH Bridge	Y		North	
25.84	Indian Brook	UG Bridge	N			New structure required
26.08	Howe Street	OH Bridge	Y		North	
26.35	Sudbury River	UG Bridge	N	Ashland		New structure required
27.34	River Street/Route 85	UG Bridge	N	Southborough	North	New structure required
27.4	Southborough Station	Station	N			Inpacts to platform and parking. Wetland southwest of station
28.02	Bridge Street	OH Bridge	Y			Realign tracks under bridge
28.2	CP28	Control Point		Southborough	North	May require tying CP into new freight track
28.92	Fruit Street	OH Bridge	N	Westborough	North	New structure required. Wetlands NW, NE and SE quadrants
29.30	Mass. Turnpike	OH Bridge	N?		North	New structure required if unable to go north of existing pier. Wetlands both sides
29.52	Route 495	OH Bridge	Y		North	Wetlands both sides
29.4 - 30.3	Westborough Auto Facility	Yard			South	CSX AF on north side, wetlands on both sides
31.99	East Main Street	UG Bridge	N		North	New structure required
32.22	Water Street	UG Bridge	?		North	
32.5	Primary Colors ?	Siding			North	
32.71	Route 135	OH Bridge	?		North	
33.12	Mill Pond	UG Bridge	N		North	New structure required
33.18	Maynard Street	UG Bridge	N		North	New structure required
33.3	CP33	Control Point				May warrant tying CP into new freight track
33.4	Dana Film	Siding			North	
33.61	Otis Street	OH Bridge	Y		North	New structure required. Pole line, ledge and siding on south side
34.0	Westborough Station	Station	N			Impacts to platform, parking and HCP accewss ramps.Wetlands and ledge on SE side
34.04	Fisher Street	OH Bridge	? Closed		North	Remove and/or Rebuild, wetlands NW and SW sides
34.73	Arch Street	UG Bridge	Y	Westborough	South	
36.40	Pine Street	OH Bridge	N	Grafton	South	New structure required
36.4	Grafton Station	Station	N			Inpacts to platform, parking and HCP access ramps
37.20	Private Crossing	Grade Crossing			North	Requires new grade crossing and relocation of protection equipment
37.4	Grafton & Upton RR	RR Interchange			South	Requires relocating of G&U RR Lead
38.00	Cross Street	OH Bridge	Y		South	
38.24	Waterway	UG Bridge	N		North	New structure required. Wetlands on NW, SW and NE quadrants
38.6	Wyman Gordon	Siding			North	
39.0	CP39	Control Point			North	Requires new No.20 Crossover and Turnout for partial build
39.1	NE Power Line Crossing	OH Power Line		Grafton	North	
				Millbury		
39.92	Worcester Highway/Route 20	UG Bridge	Y	Worcester	North	Existing open bay on north side
40.1	Camosse	Siding			South	
40.23	Sunderland Road	UG Bridge	N		South	Modifications or new structure required, Roadway clearance issue
40.5	Sacks	Siding			South	Siding lead to be relocated
41.67	Hamilton Street	OH Bridge	N		South	Modifications or new structure may be required, ledge removal
42.78	Plantation Street	OH Bridge	Y w/Ledge Removal		South	Requires ledge removal on one or both sides pending line swing issue
43.3	CP43	Control Point			South	Requires 2 new No.10 Turnouts
43.31	Putnam Lane	UG Bridge	Y		South	Existing open bays and ties into Worcester Yard Leads

NOTE: OH = overhead bridge, UG = underground bridge

Table A-2-MBTA Commuter Rail Weekday Schedule

MBTA Commuter Rail
Framingham/Worcester Line
Effective October 31, 2005

Shaded columns designate peak hour trains.
Bikes are not allowed on peak hour trains.

MONDAY THROUGH FRIDAY

Inbound	P500	P502	P504	P506	P508	P510	P512	P514	P516	P518	P520	P522	P524	P526	P528	P530	P532	P534	P536	P538	P540
Read Down	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Dep: Worcester		606		638	707		737		816	1031			200			538			740	1140	
Grafton		618		650	719		749		828	1043			212			550			752	L 1152	
Westborough		623		655	724		754		832	1047			216			554			756	L 1156	
Southborough		632		704	733		803		841	1056			225			603			805	L 1205	
Ashland		636		708	737		807		845	1100			229			607			809	L 1209	
Dep: Framingham	605	644	700	718	747	800	815	830	853	1108	1215	200	237	345	530	615	630	730	815	1215	1230
West Natick	609	648	704	722	751	804	819	834	857	1113	1218	203	240	349	533	618	634	734		1218	
Natick	614		709	727	756	809	824	839	902	1118	1223	208	245	353	538	623	639	739		f 1221	
Wellesley Square	619		714	732		814	829	844	906	1122	1227	212	249	357	544	627	644	744		1224	
Wellesley Hills	622		718	736		817	833	847	909	1125	1230	215	252	400	548	630	647	747		f 1227	
Wellesley Farms	625		721	739		820	836	850	912	1128	1233	218	255	403	551	633	650	750		f 1230	
Auburndale	629		725	743		824		854		1131	1236	221		406						f 1233	
West Newton	632		728	746		828		858		1134	1239	224		409						1236	
Newtonville	635		731	750		832		901		1138	1242	227		412						f 1239	
Yawkey	L 642	L 710	L 737	L 756		L 838					L 1250	L 235			L 605	L 647					
Back Bay	L 648	L 716	L 744	L 803	L 818	L 845	L 854	L 913	L 930	L 1151	L 1257	L 241	L 315	L 427	L 612	L 654	L 710	L 805	L 848	L 1250	L 100
Arr: South Station	654	721	749	808	823	850	859	918	935	1156	102	247	320	432	617	659	715	810	853	1255	105

"L" Regular stop to discharge or pick up passengers.
The train may "L"eave ahead of schedule.

"f" Please notify the Conductor that you want to get off at the "f" stop and the train will make the stop.
Passengers who want to get on the train at an "f" stop must be on the platform in full view of the Engineer.

Outbound	P501	P503	P505	P507	P509	P511	P513	P515	P517	P519	P521	P523	P525	P527	P529	P531	P533	P535	P537	P539
Read Down	AM	AM	AM	AM	AM	AM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM
Dep: South Station	510	650	705	735	900	1100	1205	105	240	410	430	458	505	530	605	620	715	820	1005	1125
Back Bay	515	655	710	740	905	1105	1210	110	245	415	436	503	510	535	610	625	720	825	1010	1130
Yawkey						1108					438		513	538		628	723	828	1013	1133
Newtonville						1118	1221	121	256		448		524	549		638	732	838	1023	1143
West Newton						1121	1224	124	259		451		527	552		639	735	841	1026	1146
Auburndale						1124	1227	127	302		455		530	556		644	739	843	1028	1148
Wellesley Farms					921	1128	1231	131	306		459		534	600		648	743	847	1032	1152
Wellesley Hills			728	759	924	1131	1234	134	309		503		537	604		652	746	850	1035	1155
Wellesley Square		L 715	732	803	928	1134	1237	137	312		507		540	608		656	750	853	1038	1158
Natick			737	808	933	1139	1242	142	317		512		545	613		701	755	858	1043	1203
West Natick		721	741	812	937	1143	1246	146	321	440	516	528	550	617	635	705	800	903	1048	1208
Arr: Framingham	550	725	745	817	941	1147	1250	150	325	445	520	533	555	621	640	710	804	907	1052	1212
Ashland		730			946		1255			451		539		627	646		809	912	1057	
Southborough		734			950		1259			455		543		631	650		813	916	1101	
Westborough		743			959		108			504		552		640	659		822	925	1110	
Grafton		L 747			L 1003		L 112			L 509		L 557		L 645	L 704		L 826	L 929	L 1114	
Arr: Worcester		801			1017		126			523		611		659	718		840	943	1128	

TABLE A-3
CSXT BOSTON LINE - FRAMINGHAM TO WORCESTER
EXISTING TRACK CONNECTIONS, SIDINGS AND CONSIGNEES

MILE POST	TRACK	DIRECTION	TRACK CONNECTIONS AND SIDINGS (Siding Consignees noted in bold italics)	CITY/TOWN	REC/FOR	BUSINESS TYPE	COMMODITY	CAR TYPE(S)	VOLUME* Monthly	VOLUME* Yearly	SIDING CAPACITY	NOTES
QB 21.20	2	FPE	Framingham Secondary	Framingham								Framingham Secondary accesses S.E. Mass.
QB 21.25	1 & 2	LH	CP-21 Crossover	Framingham								
QB 21.30	1	FPW	East Wye to North Yard	Framingham								North Yard is origin of local freights serving eastern Mass.
QB 21.50	***2***	***FPE***	***Holliston Industrial Track***	***Framingham***	***Receives***	***Auto Yard***	***Automobiles***	***Auto Racks***	***450***	***5400***	***40 C / 4 trks***	***Holliston Industrial Track accesses Auto Yard and CP Yard***
QB 21.55	1	FPE	Lead to North Yard and X-over to 3rd Iron	Framingham								
QB 21.60	1 & 2	RH	CP-22 Crossover from Trk 2 to 1	Framingham								
QB 21.65	1	RH	CP-22 Crossover from Trk 1 to 3rd Iron	Framingham								
QB 21.70	1 & 2	LH	CP-22 Crossover from Track 1 to 2	Framingham								
QB 21.85	2	FPW	East End of 4th Iron Siding	Framingham								
QB 22.10	***Yard***	***FPW***	***Corn Syrup Distributor***	***Framingham***	***Receives***	***Food Products Dist.***	***Liquid Sweeteners***	***Tank***	***60***	***750***	***22 C / 3 trks***	***Accessed from Nevins Yard and 3rd Iron***
QB 22.85	1	FPE	West End of 3rd Iron (to Nevins Yard)	Framingham								
QB 22.90	2	FPE	West End of 4th Iron Siding	Ashland								
QB 24.45	1 & 2	LH	CP-24 Crossover	Ashland								
QB 24.50	1 & 2	RH	CP-24 Crossover	Ashland								
QB 28.10	1 & 2	RH	CP-28 Crossover	Southborough								
QB 28.15	1 & 2	LH	CP-28 Crossover	Southborough								
QB 29.30	1	FPW	East End Westborough Yard Lead	Westborough								
QB 29.35	***Yard***	***FPE***	***Cumberland Farms Siding***	***Westborough***	***Receives***	***Food Products Dist.***	***Plastic Resins***	***Covered Hop***				***Has not received cars for many years***
QB 29.60	***Yard***	***FPW***	***Staley***	***Westborough***	***Receives***	***Food Products Dist.***	***Liquid Sweeteners***	***Tank***	***100***	***1200***	***5 C / 2 trks***	
QB 29.85	***Yard***		***Westborough Auto Unloading Facility***	***Westborough***	***Receives***	***Auto Yard***	***Automobiles***	***Auto Racks***	***500***	***6000***	***48 C / 6 trks***	
QB 30.25	1	FPE	West End Westborough Yard Lead	Westborough								
QB 31.25	2	***FPW***	***Bay State Abrasives (Formerly)***	***Westborough***								Company no longer at site, siding is unused.
QB 32.55	2	***FPW***	***Primary Colors***	***Westborough***	***Receives***							Building unoccupied, siding not used, turnout in curve
QB 33.25	1 & 2	LH	CP-33 Crossover	Westborough								
QB 33.35	1 & 2	RH	CP-33 Crossover	Westborough								
QB 33.40	2	***FPW***	***Dana Films***	***Westborough***	***Receives***	***Plastic Wrapping***	***Plastic Resins***	***Covered Hop***	***30***	***350***	***7 C / 1 trk***	
QB 37.55	2	***FPW***	***Grafton and Upton Railroad***	***Grafton***	***Receives***							Short Line RR with transload plus 1 active consignee
QB 38.60	2	***FPW***	***Wyman Gordon***	***Grafton***	***Receives***	***Large Machinery***	***Solvent Cleaners***	***Tank***				Does not appear to be using rail service
QB 38.90	1 & 2	RH	CP-39 Crossover	Grafton								
QB 40.10	1	***FPE***	***Camosse***	***Millbury***	***Receives***	***Building Materials***	***Bricks and Bldg. Mat***	***Box***	***5***	***60***	***4 C / 1 trk***	***Turnout is in curve***
QB 40.55	2	***FPW***	***Sacks***	***Millbury***	***Receives***	***Food Products Dist.***	***Unknown***	***Reefer & Box***	***60***	***750***	***9 C / 1 trk***	
QB 43.20	1& 2	LH	CP-43 Crossover	Worcester								
QB 43.25	2	FPW	East End Worcester Yard	Worcester								
QB 43.55	1 & 2	RH	CP-44 Crossover	Worcester								
QB 43.65	1	RH	Crossover to Station Trk/Layover Lead	Worcester								
QB 44.25	2	FPE	West End Worcester Yard	Worcester								
QB 44.28	1	FPE	West end Station Track	Worcester								
QB 44.45	1	FPE	WN&P Connection to North	Worcester								
QB 44.55	1 & 2	RH	CP-45 Crossover	Worcester								
QB 44.60	1	FPW	Connection to Providence & Worcester RR	Worcester								
QB 44.65	1 & 2	RH	CP-45 Crossover	Worcester								
QB 44.70	2	FPW	East end of Storage Siding	Worcester								
QB 45.95	2	FPE	West end of Storage Siding	Worcester								

Track 1 is northerly track or outbound in normal right hand running
Track 2 is southerly track or inbound in normal right hand running

* Volume data is based solely on observation and estimation

LH = Left hand Crossover
RH = Right hand Crossover
FPW/E - Facing Point West or East. - Direction of single turnout connection